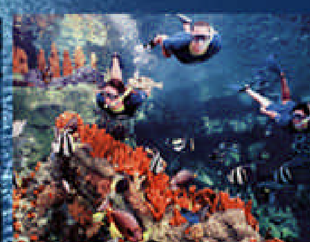
Kona Kai Ola

FINAL ENVIRONMENTAL IMPACT STATEMENT

VOLUME 2-A: EISPN & EIS COMMENTS AND RESPONSES

Kealakehe, North Kona District, Island of Hawaii




Prepared for:
Jacoby Development, Inc.
171 17th Street, NW, Suite 1550
Atlanta, GA 30363

For Accepting Authority:
Hawai'i State Department
of Hawaiian Home Lands
1099 Alakea Street, Suite 2000
Honolulu, HI 96813

Prepared by:
oceanit
828 Fort Street Mall, Suite 600
Honolulu, HI 96813

In Cooperation with:
Hawai'i State Department
of Land and Natural Resources
1151 Punchbowl Street, Room 130
Honolulu, HI 96813

JULY 2007

Appendix A

Comment Letters and Responses as Part of the Public Notice of the EISPN

LINDA LINGLE
GOVERNOR OF HAWAII

GENEVIEVE SALMONSON
DIRECTOR

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
235 SOUTH BERETANIA STREET
SUITE 702
HONOLULU, HAWAII 96813
TELEPHONE (808) 586-4185
FACSIMILE (808) 586-4186
E-mail: oeqc@health.state.hi.us

August 2, 2006

Peter Young
Department of Land & Natural Resources
PO Box 621
Honolulu, HI 96809

Attn: Russell Tsuji or Keith Chun

Subject: Environmental impact statement (EIS) preparation notice, **Kona Kai Ola**

Dear Mr. Young:

We have the following comments:

Two-sided pages: Be sure to print on both sides of the pages in the EIS. HRS 342G-44 now requires double-sided copying in all state and county agencies, offices and facilities.

Acronyms list: To your list add NPDES and NOAA.

Contacts: If you received any correspondence during the preconsultation period, include copies in the draft EIS along with copies of your responses.

Natural hazards: If there is any unstable soil in the project area, include a discussion of it, along with associated mitigation measures, in the draft EIS.

Cumulative impacts: In the draft EIS include a thorough discussion of cumulative impacts for this project in relation to any others in the region which are planned or under construction. Be sure to check with the Hawaii Planning Department and this office to identify all other projects.

Timeshare and hotel units:

For the timeshare and hotel units, please consider applying sustainable building techniques presented in the "Guidelines for Sustainable Building Design in Hawaii." In the EIS include a description of any of the techniques you will implement. Go to our website at *http://www.state.hi.us/health/oeqc/guidance/sustainable.htm* or contact our office for a paper copy of the guidelines.

In the draft EIS indicate the total population at full buildout of these units.

Community meetings: In the draft EIS include a synopsis of issues raised at the presentations. Transcripts are not required, only a synopsis.

Air quality: The air quality study should take vog into consideration as it seriously affects air quality. Also discuss the emissions from the nearby quarry, wind patterns in this region, and how you will mitigate the negative effects.

If you have any questions, call Nancy Heinrich at 586-4185.

Sincerely,

Genevieve Salmonson

GENEVIEVE SALMONSON
Director

c: Jeff Merz, Oceanit

oceanit.
innovation through engineering & scientific excellence

August 2, 2006

State of Hawaii
Office of Environmental Quality Control
Attn: Genevieve Salmonson, Director
235 South Beretania Street, Suite 702
Honolulu, HI 96813

Ms. Salmonson:

Thank you for your comments to the EIS Preparation Notice for the Kona Kai Ola development on the Island of Hawaii and for your participation in the EIS process.

We concur with your requested changes and all will be incorporated into the Draft EIS for the Kona Kai Ola project.

- The draft EIS will be printed on both sides.
- NPDES and NOAA will be added to the acronym list
- I have not received any comments or correspondence during the pre-consultation stage, but will inquire with others on the project, and include any in the draft EIS.
- I will confirm any presence of unstable soil and discuss it in the draft EIS.
- The cumulative impacts will be discussed in detail including project relationships to others in the region, planned or under construction.
- I will direct the developer to consider applying "Guidelines for Sustainable Building Design in Hawaii".
- The estimated population at full build-out will discussed.
- The draft EIS will include a synopsis of issues from the community presentations.
- The air quality analysis will discuss 'vog' and its impacts.

Again, thank you for your input.

Sincerely,

Jeff Merz, AICP
Senior Planner

Oceanit Center 828 Fort Street Mall, Suite 600 Honolulu, Hawaii 96813 Phone: 808.531.3017 Fax: 808.531.3177
www.oceanit.com

LINDA LINGLE
GOVERNOR
STATE OF HAWAII

MICAH A. KANE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

BEN HENDERSON
DEPUTY TO THE CHAIRMAN

KAULANA H. PARK
EXECUTIVE ASSISTANT

STATE OF HAWAII

DEPARTMENT OF HAWAIIAN HOME LANDS

P.O. BOX 1879
HONOLULU, HAWAII 96805

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July 20, 2006

Mr. Jeff Merz
Oceanit
828 Fort Street Mall, Ste. 600
Honolulu, Hawaii 96813

Dear Mr. Merz:

Subject: Review of July 2006, Environmental Impact Statement Preparation Notice for Proposed Kona Kai Ola Development, Kealakehe, North Kona District, Island of Hawaii

Thank you for the opportunity to comment on the Environmental Impact Statement Preparation Notice (EISPN) for the subject property referenced above, and to participate in the environmental review process.

We have reviewed the report and offer the following comments:

➢ Section 1.1.Overview
- Approving Agency should also include;
  Department of Hawaiian Home Lands (DHHL)
  Hawaiian Homes Commission
  State of Hawaii
  P. O. Box 1879
  Honolulu, Hawaii 96805

➢ Section 1.3.Project Objectives and Proposed Action
- Revise second sentence of first paragraph to read as follows; The land has been identified by DHHL as one of the only major DHHL parcels with income-generating potential on the west side of the Island of Hawaii.

- Revise second sentence of third paragraph to read as follows; The Department of Land and Natural Resources (DLNR) and DHHL agreements with Jacoby Development Inc. (JDI) provided that, as part of its proposed master development plan, JDI will arrange to design and construct two major public infrastructure improvements: the 800-slip harbor contiguous to the existing Honokohau Harbor and the Kealakehe Parkway extension and Improvements.

➢ Section 1.4.Proposed Project
- Point of note; Project is expected to be built in phases over an estimated fourteen (14)-year period. DHHL expects its commercial component to be completed and operational in early phases of construction.

➢ Section 4.5.1 Population, Economy and Housing

- Revise third sentence of fifth paragraph to read as follows; DHHL intends to use revenues from these commercial lands to fund homesteads further mauka and around the State of Hawaii.

We request that the comments be addressed and the necessary revisions be made to the referenced EISPN. We would also appreciate a more detailed report with the proposed revisions before you finalize your draft EIS for the proposed project.

If you have any questions, please contact Peter "Kahana" Albinio, Jr., Land Agent, Land Management Division at (808)587-6429.

Aloha and mahalo,

Linda Chinn, Administrator
Land Management Division

oceanit.
Innovation through engineering & scientific excellence

July 25, 2006

State of Hawaii
Department of Hawaiian Home Lands
Attn: Linda Chinn, Administrator
Land Management Division
P.O. Box 1879
Honolulu, HI 96805

Ms. Chinn:

Thank you for your comments to the EIS Preparation Notice for the Kona Kai Ola development on the Island of Hawaii and for your participation in the EIS process.

We concur with your requested changes and all will be incorporated into the Draft EIS for the Kona Kai Ola project.

- DHHL will be included as an Approving/Accepting Agency in Section 1.1
- The two requested verbiage changes will be made to Section 1.3
- The phasing comments will be added to Section 1.4
- The revenue reference will be added to Section 4.5.1.

Finally, prior to submittal of the Draft EIS to OEQC for publication, the document will be circulated to you incorporating all proposed revisions.

Again, thank you for your input.

Sincerely,

Jeff Merz, AICP
Senior Planner

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www.oceanit.com

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Scott Condra
Jacoby Development, Inc./Kona Marina Development,
LCC, 171 17th St, NW, Ste 1550,
Atlanta, Georgia, 30363

Board of Land and Natural Resources
P. O. Box 621
Honolulu, HI 96809

✓Jeff Merz
Oceanit Center
828 Fort Street Mall, 6th Flr, Honolulu, HI 96813

Genevieve Salmonson
OEQC
235 S. Beretania St. #702
Honolulu, HI 96813

August 1, 2006

Aloha:

The Sierra Club wishes to be a consulted party pursuant to chapter 343. The DEIS and FEIS should fully discuss the following issues:

The EIS should discuss the highly permeable nature of the lava in the area.

The EIS should include any calculations or models used to support any conclusion regarding runoff and drainage into nearshore waters and anchialine pools.

A complete EIS will reveal the cumulative impact of all runoff and leaching on coastal waters. This includes pesticides/biocides (including the impact of the alternative biocides that are lower in toxicity), fertilizers, sedimentation, heavy metals, grease, other urban runoff, and the increase in sewage effluent. To understand the full cumulative impact, the EIS should examine the impact of runoff traditionally associated with coastal development, including sediment runoff during construction, waste oil and other rubbish associated with urban uses. It should study the amount of nonpoint source water pollution associated with similar developments and discuss the degradation of coral reefs and coastal water quality caused by similar hillside projects. A complete EIS would not glibly assume that mitigation measures would take care of all nonpoint source water pollution problems.

How much contaminated water (by nutrients, pesticides, or other contaminants) can be expected to leach through the porous lava and make its way into the coastal waters (i.e, not surface runoff, but percolation)? What specific studies of similar areas on the Big Island does the EIS rely on to support its conclusions? The recent water quality study prepared for the County of Hawai`i by the Marine Science Department of the University of Hawai`i at Hilo which showed significant impact on nearshore water quality by coastal development should be referenced.

What are the current levels of all the pollutants identified in Hawaii Administrative Rules 11-54-04 measured at the shoreline of this project? How will each of these levels change in front of this project if it is fully built-out?

How many tons of soil will need to be imported? Where will it come

from? What will be the impact to water quality of this new source of silt?
The EIS should include a detailed archaeological inventory that considers the presence of burials, petroglyphs and other historic sites.

The EIS should disclose the criteria the consultant used to determine whether specific historic sites should be preserved in place or merely "data recovered" and whether these decisions were agreed to by SHPD after an on-site inspection.

How will the presence of this development and its population affect subsistence use of this area and the adjacent Kaloko-Honokohau National Park?

How will an expanded marina affect the safety of boaters? Will an expanded harbor require construction of a breakwall? How will an expanded harbor and breakwall affect the configuration of the beach as well as the health of the coral reef? If the reef is changed, how will that affect cultural uses, including surfing, subsistence fishing, gathering?

How will transient marine life, especially the large sea turtle population which rests at this shoreline and humpback whale population which spends several months there each winter, be affected?

How will the presence of this development affect the scenic experience at Kaloko Honokohau National Park?

The EIS should discuss the results of the survey of 1,000 Maui tourists (A VISITOR'S VIEW OF PARADISE: A REPORT ON MAUI'S VISITORS . . . WHY THEY COME, WHAT THEY ENJOY, WHY THEY RETURN). Among the results:

o The most memorable part of visitors' trip was "excursions into Nature."
o The feature that most visitors said that they would like to see more of was "natural coastlines"
o 91% reported that the preservation of natural areas was very important in their decision to return to visit.

According to the Hawaii Tourism Authority's own survey, 72% of residents oppose more hotel construction. The EIS should

disclose this fact. The EIS should also disclose the current occupancy rate on Hawai`i Island - and compare the vacancy rate here with other counties.

The EIS should fully disclose how the county will handle the solid waste generated from this project and how much it will shorten the expected lifetime of the Pu`uanahulu Landfill. The EIS should not glibly declare that the impacts will be mitigated.

Please fully discuss how the public can be assured that any proposed mitigation measures will be performed and will be effective. Please describe the county and state government's monitoring and enforcement programs so that we can be assured that promises made will be kept. How much staff do the State Health Department, County Public Works Department and County Planning Department have to ensure that promises are kept? How often can they be expected to visit the site? Please do not argue that it is beyond your ability to answer these questions. Please ask the departments themselves. Please report how shorthanded they report that they are.

The applicant should identify all proposed mitigation measures in a consolidated list. These measures should be written in plain language that is easily enforceable when incorporated into a permit. It is unacceptable, for example, to list as a mitigation measure that "apply pesticides only when and where necessary" since such language is open to far too much interpretation and completely unenforceable.

Mahalo a nui loa,

Janice Palma-Glennie
West Hawai`i Conservation Chair
for the Mokul Loa Group
Sierra Club

Innovation through engineering & scientific excellence

October 20, 2006

Sierra Club
Janice Palma-Glennie
West Hawaii Conservation Chair
Moku Loa Group
P.O. Box 1137,
Hilo, Hawai'i 96721-1137

Dear Ms. Palma-Glennie:

Thank you for your comments to the EIS Preparation Notice for the Kona Kai Ola development on the Island of Hawai'i and for your participation in the EIS process.

The Sierra Club-Moku Loa Group will be included and referenced in the Draft EIS as a consulted party. Your comments will be addressed and will be incorporated into the Draft EIS for the Kona Kai Ola project.

The philosophy of the Sierra Club runs parallel to many goals of sustainable development to which the Kona Kai Ola project is committed. Because of the unique location of the project adjacent to the National Historical Park, an existing and expanded harbor, and a culturally and ecologically sensitive coastline, the developer has mandated that the project will follow sustainability guidelines. The Kona Kai Ola development will aspire to be the first Low Impact Design, Leadership in Energy and Environmental Design (LEED)-certified sustainable development in Hawai'i. This process involves a very conscious effort to understand the workings of existing natural processes on the land and then to derive infrastructure plans that work with natural systems to the greatest extent possible. This is followed by the creation of a built environment that is energy efficient, and entices people to walk more and drive less. With the help of concerned community members and responsible scientists we hope to set a new standard in the way developments relate to the surrounding natural and social environment to create long term sustainable communities. We hope that this overall development goal will serve as a basis for productive discussions between the Sierra Club and project designers. Your efforts to assist us towards this goal are appreciated.

Below are responses to your comment letter dated August 30, Questions from your letter are paraphrased below in italics, followed by the response. Some related questions have been grouped followed by a summary response.

1. Discuss the highly permeable nature of the lava in the project area.

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www.oceanit.com

2. Include calculations or models used to support conclusions regarding runoff and drainage into nearshore waters and anchialine ponds.

3. Reveal the cumulative impacts of all runoff and leaching on coastal waters. This includes pesticides/biocides, fertilizers, sedimentation, heavy metals, grease, other urban runoff, and the increase in sewage effluent. The EIS should examine the impact of runoff traditionally associated with coastal development, including construction runoff and sediment, non-point source water pollution associated with similar developments and the degradation of coral reefs.

4. Discuss the quantity of contaminated water anticipated to leach through the lava to coastal areas. Specific, relevant studies should be referenced to support any conclusions.

5. Analyze current levels of all pollutants identified in HAR 11-54-04 measured at the shoreline and any changes anticipated with full project build-out.

Numerous professional consulting firms are in the process of completing coordinated studies to analyze the concerns raised in your questions above.

Waimea Water Services is in the process of completing the Hydrology/Groundwater Impact Analysis. This scope of work involves understanding the dynamics of groundwater chemistry and hydraulics in the vicinity of the proposed Honokohau Harbor Expansion to accurately predict the impact of these flows to the new harbor and the impact of the harbor on fresh (brackish) water resources beneath adjoining properties, impacts of wastewater reuse, and storm runoff impacts to the site. This information will be used to formulate an updated description of the geology and groundwater hydrology in the project area. WWS is working with **AECOS Laboratory of Hawai'i, LLC** to obtain water quality measurements within the wells to assist in the prediction of fresh water and dissolved nutrient flows in the groundwater. This information will be compiled into a report along with recommendations for mitigation of any impacts identified during the study. To accomplish this goal Waimea Water Services (WWS) is currently working to:

- Recommend specific locations for the collection of water samples and the analyses to which these samples should be tested;
- Establish water level recordings in wells;
- Integrate geological information from existing studies with new information obtained from new borings on site;
- Use information from historical sources and bore logs from new holes to develop a description of the underlying geology of the site;
- Coordinate water sampling and analyses of water quality by AECOS Laboratory of Hawai'i, LLC at various wells and well depths to better understand the quantity and quality of groundwater;
- Review information from the above analyses and all other available historical observations and including recent observations by other researchers on adjacent parcels. These will be integrated into a cohesive description of groundwater dynamics of the project site. This understanding will be used to develop a description of potential impacts to and from marina development, wastewater injection and reuse, and storm runoff;

- Prepare recommendations for mitigation. A final report will be prepared suitable for public release that describes and integrates all of the activities and information obtained in this study.

Oceanic Institute in conjunction with **AECOS Laboratory of Hawai'i, LLC** is completing water quality testing and a Marine Biological Baseline Monitoring and Mitigation Plan. The work is being conducted to determine the current conditions of water quality and aquatic resources and habitats within and adjacent to Honokohau Harbor, the proposed Kona Kai Ola site, and at sites potentially impacted by the proposed development including increased runoff and drainage. Potentially-affected aquatic resources and habitats including benthic and fish communities associated with nearshore coral reefs, recreational and commercial fisheries, anchialine ponds and associated organisms, are being analyzed. Current research is being conducted to investigate any studies of generic impacts to coastal water quality and nearshore marine ecology

The study includes review of historical data for the affected areas, field data collection, data analysis, reporting, discussion and evaluation of potential impacts associated with proposed development activities, changes in runoff, sedimentation and possible increases in pollution. Biota monitoring will be performed in each of the anchialine ponds located within or immediately adjacent the project site. The frequency, location and scope of the proposed baseline surveys, water pollutant testing and analyses have been designed to incorporate the current requirements of local and federal permitting agencies, and recognize the sensitive nature of adjacent areas, including the Kaloko-Honokohau Natural Historical Park and numerous popular dive and shoreline fishing sites.

It is known and documented that freshwater intrusion into the current marina and near shore areas causes many parameters to be out of compliance with the State Standards for water quality. (Hawai'i Administrative Rules, Title 11, Department of Health, Chapter 54). Therefore, **AECOS Laboratory of Hawai'i, LLC,** will be completing water quality testing. According to the HAR, Title 11, Department of Health, Chapter 54-06, the West Side of Hawai'i has unique conditions for baseline studies. While HAR Chapter 54 sets forth the fundamental concepts and standards for marine water quality, the water quality consultant, AECOS Laboratory of Hawai'i, LLC is ensuring that the Kona Kai Ola project also is consistent with the additional criteria of the West Hawai'i Coastal Monitoring Program. The accumulated data is then to be reviewed with other project data along the West Hawai'i coastline. Existing documents related to West Hawai'i water quality will be referenced, including any University of Hawai'i at Hilo or other studies relevant to the project.

Water quality testing efforts were coordinated with Waimea Water Service and Oceanic Institute to select proper sites for groundwater borings. Water samples are being collected from all significant anchialine ponds located within the project boundaries, on either side of the harbor entrance channel. All pollutants will not be measured. Instead testing will be limited to ones that are reasonable to be suspected on or near the site. Testing parameters have been discussed with the National Park Service. The following parameters will be tested:

Water Quality Parameters - Near Shore Waters	
Chlorophyll *a*	µg / liter
Turbidity	NTU
Hydrogen ion concentration (pH)	units
Fecal Coliform	colony forming units (CFU) / 100 ml
Enterococci	colony forming units (CFU) / 100 ml
Nitrite plus Nitrate Nitrogen	µg N / liter
Ammonia Nitrogen	µg N / liter
Total Dissolved Nitrogen	µg N / liter
Phosphate	µg P / liter
Total Dissolved Phosphorus	µg P / liter
Salinity	parts per thousand (ppt)
Temperature	Degrees C.
Dissolved Oxygen	mg / liter
Silicate	µg Si / liter
Dissolved organic phosphorus	µg P / liter
Dissolved organic nitrogen	µg N / liter
Sea and weather conditions	to be noted

From: West Hawai'i Coastal Monitoring Program, Monitoring Protocol Guidelines, page 10, May 1992

Moffatt & Nichol, the engineering firm tasked with the marina design, is using the *DELFT3D* numerical model to analyze the impact of groundwater flows to the harbor and the impact on harbor currents and flushing rates. In order to determine impacts from the proposed Kona Kai Ola development, it is essential to accurately model these density currents and the stratification that occurs when fresh water enters the marina. Hydrodynamic models simulations will be used to assess both existing conditions and future marina development impacts on existing conditions. Information from the above studies on existing groundwater and harbor water quality will be used to complete simulations of impacts with and without various project conditions. All methodologies, results and conclusion will be assembled into a report for inclusion into the Draft EIS.

Oceanit is conducting a Zone of Mixing study using existing information, current measurements, water quality stratification measurements, and model results from the Moffatt & Nichol study. This study involves:

- ✓ Installing recording instruments to monitor salinity, temperature, pH, turbidity and dissolved oxygen concentration ;
- ✓ Obtaining current data presently being collected by USGS for the offshore area;
- ✓ Conducting water quality profiles along the shoreline during flood and ebb tides;
- ✓ Conducting water quality measurements in the harbor outflow plume;
- ✓ Using results from the Moffatt & Nichol study to project the predicted zone of mixing out into the nearshore waters.

A report is being prepared which estimates mixing levels and water quality variations in the nearshore area adjacent to the harbor entrance to determine the effective zone of mixing (ZOM), variations, dispersion and future water exchange. The report will evaluate impacts on surface water uses in the adjacent areas. This information will then feed back into the analyses conducted by Oceanic Institute to predict impacts to nearshore marine communities.

6. *Discuss grading and filling quantities and qualities.*

To create additional harbor space as required by the DLNR agreement, the project will remove approximately 2 million cubic yards of material over an area of about 45 acres. Additional material will be removed from around the harbor and beneath the planned shore-side artificial lagoons to terrace these into naturally-appearing undulations. This will create a marina and lagoon area that is accessible and user friendly while also lowering the profiles of adjacent buildings. This excavated material is planned to be re-used on site during construction

7. *Contain a detailed archaeological study including any burials, petroglyphs, other historical sites, along with an analysis of previous relevant studies, disclosure of criteria for preservation, and any concurrence from SHPD.*
8. *Analyze project impacts on subsistence use of the area and the adjacent National Historical Site.*

Dr. Alan Haun and Associates is completing the archaeological inventory for the DLNR portion of the project area as well as for the proposed Kealakehe Parkway extension through Queen Lili'uokalani Trust lands. **Dr. Taupouri Tangaro** is completing the Cultural Impact Assessment for this site and the surrounding culturally significant area. These two studies will be combined with the existing archeology and cultural studies for the DHHL portion of the project site, for a comprehensive analysis of the project area. All will be included as part of the Draft EIS.

The archaeological studies involve background review and research, consultation with appropriate cultural representatives regarding culturally significant sites and subsistence use of the area, a full pedestrian reconnaissance survey, detailed recording of all potentially significant properties including scale plan drawings, written descriptions, and photographs and subsurface testing at selected sites.

Upon completion of fieldwork, Dr. Alan Haun and Associates will prepare and submit a site location map and list of sites with tentative significance assessments and recommended treatments along with a survey report for the Draft EIS, in conformance with regulatory agency requirements (including State Historic Preservation Division (SHPD)) for inventory survey reports. The report will include significance assessments and specific recommendations for any further archaeological work that might be required. In addition, Dr. Alan Haun and Associates will submit a final report to Oceanit formally addressing any comments from DLNR-SHPD and public comments from the Draft EIS.

9. *Analyze boat traffic, safety and any construction impact on the coral reef and its uses including surfing, subsistence fishing and gathering.*

A marina boat traffic study is being completed by **Moffatt & Nichol**. It is important both from a marina planning point of view and as an important element of the Environmental Impact Study (EIS) for the overall project. The proposed project will add marina slips that will access the ocean via the existing marina entrance channel which will not be modified. The focus of this study is to address impacts of the proposed project to existing navigation. Tasks include a review of available reports and data relevant to the existing marina including slip mix and usage. Details of the marina layout including entrance dimensions for navigation will be obtained. Moffatt & Nichol is collecting observations of the existing marina during peak weekend usage, general marina function and traffic patterns. They are also conducting interviews with stakeholders and the harbor master. Boat counts are being taken in the entrance channel over two weekends and one weekday to help quantify boat usage patterns. The results of the preceding tasks are being applied to provide a quantitative assessment of the existing traffic levels within the marina entrance.

Standard marina entrance design guidelines for safe navigation are being reviewed to assess the entrance usage in terms of percent capacity, analogous to a level-of-service assessment for traffic analyses. At this time, a breakwater is not proposed. Other marina sites are being investigated for comparison of size, slip count, entrance width and environmental conditions. Usage patterns measured for the existing marina are being applied to the proposed marina alternatives to quantify traffic levels. Boat traffic impacts to the existing marina are being assessed. Any required mitigation measures will be developed as appropriate. Finally, Moffat & Nichol is preparing a report summarizing the study findings and recommendations for inclusion in the Draft EIS.

The cultural and social impact assessment studies will address subsistence activities, cultural uses and surfing

10. *Include an assessment of the impacts on the marine ecosystem and transient marine life, including the sea turtle and humpback whale population.*

Oceanic Institute is completing water quality testing and a Marine Biological Baseline Monitoring & Mitigation Plan to address the impacts to the marine ecosystem. A marine biological survey has been conducted to establish baseline conditions. Primary biological communities included in the surveys are:

- Biological communities in two clusters of natural anchialine ponds located north and south of the Honokohau Harbor entrance channel;
- Benthic communities along transects located at each of nine (9) offshore survey sites;
- Fish communities occurring within the nine (9) offshore survey sites;
- Benthic communities within Honokohau Harbor;
- Fish communities within Honokohau Harbor.

Species diversity is calculated for coral and algal communities using the Shannon-Weaver Index formula. A final report will include recommendations to address any impacts to the marine environment.

11. *Analyze visual impacts that the development may have on the scenic experience from the Kaloko-Honokohau National Historical Site.*

The project designers are striving to create a project that has adequate open space, low rise buildings, and aesthetically-appealing view planes. The preliminary design of the structures, density, location and landscaping will be reviewed as part of the Draft EIS. Once the plan is formalized at the entitlement stage, these will be discussed and publicly reviewed as part of the rezoning request, SMA, Corp of Engineers and CDUA permits. All proposed development will be required to comply with any applicable National Park Service policies and requirements related to aesthetics and visual impacts on non-NPS properties.

12. *Discuss the impacts to the visitor industry and the community's input on the impact of the visitor industry. The EIS should discuss Maui and Hawai'i Tourism Authority's surveys along with current occupancy rates.*

John Knox and Associates is analyzing this as part of the Social Impact Assessment. While analyzing the full range of social impacts from this proposed development, as expressed by those in the community. The study is to provide an analysis of the social impact from this project on the community, the economy and the visitor industry of the Island of Hawai'i. Specifically, this study is to disclose the community's concerns, preferences, ideas and recommendations for this project and the greater community through community surveys, review of existing background information and forecasts. An economic analysis currently being completed by **Hallstrom Group,** will analyze the visitor industry economics including occupancy rates for the West Hawaii visitor market, and the full range of market conditions including economic impacts to existing community services

13. *Analyze the impacts from this project on the Pu'uanahulu Landfill.*

As noted in the Hawai'i County Integrated Solid Waste Management Plan, as updated in 2002, "Pu'uanahulu Landfill has more than 12,000,000 cubic yards of permitted air space, which should be enough to accommodate the [current] waste stream from west Hawai'i for approximately 40 years. However, diversion of waste by recycling and the use of waste reduction technologies would reduce the disposed waste stream and extend the life of the landfill."

The developer intends to seek LEED certification with this development. One part of LEED criteria is to "reduce the amount of waste material that is generated (waste material that ends up in landfills or incinerators) and to reduce the amount of non-renewable natural resources (including embodied energy) in constructing and operating buildings." LEED stipulates the "establishment of a recycling program for waste generated by building occupants."

As to construction waste management, LEED requires, "the development and implementation of a waste management plan. Through the plan, a project receives one point for recycling or

salvaging at least 50% (by weight) of construction, demolition, and land clearing waste. Another point is received by recycling or salvaging an additional 25% (or 75% total weight) of construction, demolition, and land clearing waste." The developer intends to pursue LEED certification for this development including complying with the waste handling stipulations above.

14. *Include a discussion of the mitigation measures to be included in the Draft EIS in a consolidated list near the front of the document, as well as in relevant sections throughout the Draft EIS. Describe the applicable County and State mitigation monitoring and enforcement programs so that we can be assured that promises made will be kept. Discuss and disclose the process by which various agencies ensure compliance with proposed mitigation measures, staffing issues, and enforcement. Discuss how short-handed agencies report they are.*

Proposed mitigations measures will be written with specificity and summarized near the front of the Draft EIS to ensure that ambiguous interpretation is limited, and enforcement and implementation would be easily facilitated. At this Draft EIS stage, the proposed mitigations are formal recommendations based on analysis. These mitigations may become conditions of approval for the full range of federal, State and County permits that would be needed for this project. The formulation of permit conditions, staffing issues, agency monitoring plans, procedures, enforcement and any agency assurances would be discussed and codified at this future permit stage and by the agencies involved.

Again, thank you for your input. Your comment letter along with this response letter will be included as part of the Draft EIS.

Sincerely,

Jeff Merz, AICP
Senior Planner
Oceanit

August 4, 2006

Jacoby Development, Inc./Kona Marina Development LLC
171 17th St. NW Ste 1550
Atlanta, GA 30363

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RECEIVED
AUG - 8 2006
LATE
After close of comment period

Re: Jacoby Development Inc./ Kona Marina Development LLC (HRS 343 FEA-EISPN)

Aloha

We are requesting that we become a consulted party in the preparation of above referenced draft environmental impact statement. (DEIS)

We would like to comment on the following:
POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT ON THE EXISTING NATURAL ENVIRONMENT

Geology, Topography, Soils. The land in which this development proposes to build consists of very porous layers of lava rock and it has open lava tubes which bring in fresh water from the mountains to the sea. Any soil improvements to allow landscaping will require the additional fertilizers, pest control, phosphates, nitrates and soil conditioners, which would have a irreparable damage to the freshwater and marine water, and of course its marine life. When the Hawai'I County re-valuated its General Plan, it chose not to give this area a zoning for Resort, because the County Council and the Mayor knew the conditions of this land and zoned it accordingly.

Groundwater and Hydrology -Blasting a massive inland marina and lagoon will in fact alter the second largest freshwater outflow from Hawai'i leeward coast which feeds and nourishes the pristine off shore coral reefs environment. This is a Maine Sanctuary area and should and cannot be altered to market an unpredictable venture. No decisions should be made to alter this natural flow of freshwater.

Marine Resources – Recent decisions by the Hawai'i State Supreme Court makes it very clear that the County of Hawai'i must carefully monitor the shorelines for erosion to from any existing new development along the Special Mangement Area. We have the laws now in place to protect our shorelines and its government must and will act responsibly.

Natural Hazards -Botanical Resources, Wildlife Resources Arthropod Resources Hawai'i must respond to the careful planning of its shoreline. We can not harm any endangered species or species that will be affected by any water pollution. The State Supreme Court has ruled now, and we must review it carefully, so that do not see a repeat of damage done in previous shoreline development.

POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT ON THE EXISTING HUMAN ENVIRONMENT

Archaeological and Historic Resources. The must be a Cultural Impact Assessment done here. We have the Kaloko-Honokohau National Historical Park on the north, which the area was established because of its rich cultural and natural resources. These resources include a heiau, Petroglyphs, anchialine ponds and the endangered hawksbill turtle. On the south of the property, the Queen Liliuokalani Trust lies, and within its boundaries lies cultural and archaeological sites. It has been stated by Mr. David Tarnas that Jacoby will request a connecting road through this property to connect with Kuakini highway. This concept is poorly stated, as there is no truth to back its availability for this project. There are known Native Hawaiian cultural practices within and adjacent to the proposed project area, including the practice of ho'oma'ema'e, ("cleansing") Elimination of such constitutionally-protected cultural and environmental resources will adversely impact constitutionally-protected cultural practices.

Roadway and Traffic This is ultimately the most serious problem that West Hawaii faces through the next 20 years. We can not add to the seriousness of gridlock traffic with a development of this magnitude. There will be an excess of hotel guests, timeshare guests, employees of both, retail owners, employees and additionally thousands coming in an out of this development hourly. The magnitude of this type of development would have to put an H-3 through this area to accommodate this flow, and the West Hawaii residents do not want this kind of development as they made clear in the revision of the General Plan. The Kona Community Development Plan has indicated this area should stay in open protected space. We have approved zoned homes within this area which will add to our daily count of travelers in and around Kailua Kona. The Hawai'i County Planning Director Chris Yuen has given his unfavorable recommendation to the County Council. It has proved to be very valuable as County Council has not deleted any resolutions for review of any changes to the General Plan for now. This property does not have a Resort zoning in our General Plan.

Socio-Economic Impacts – Social Impacts- Population – Housing Units West Hawaii has almost one of the lowest unemployment rates in the country. Business owners have almost no employment pool to train prospective employees. It is at a crisis level, and the high cost of living, plus the high price of real estate, makes it very unattractive to move here with rental prices being higher than mortgage payments. The average wage does not compute for those wanting to buy a home. This development has plans for a huge 52 acre plan for retail stores, but does not give an alternative for affordable housing for employees. We are back to excessive traffic issues for those employees.

Character of Community - The expansion of the Honokohau Small Boat Harbor brings extensive problems. There can not be blasting of this harbor without having an impact on the existing harbor. This is a poorly planned concept and should not be even considered. It could violate federal, state and county laws that protect shorelines. The character of this fishing village and its people depend on the visitor industry and does not want to change its character to resemble a California community. The community and its resident want to savor this character for generations to come.

There are alternative uses for this property, which have not been reviewed. These state lands could better serve its people by allowing an Ocean- Marine Center to be built for the enjoyment of its residents and visitors. The prospects of having a center like this is very viable. The island of Maui has shown us that a Marine center brings new life to its island.

Make the right decision for the island of Hawaii, our quality of life depends upon it.

Sincerely,

Marie Aguilar

Marie Aguilar

Philip Mosher

Philip Mosher

P.O Box
1874
Kailua-Kona
96745

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oceanit.
innovation through engineering & scientific excellence

October 20, 2006

Marie Aguilar
Philip Mosher
P.O. Box 1874
Hilo, Hawai'i 96745

Dear Ms. Aguilar and Mr. Mosher:

Thank you for your comments to the EIS Preparation Notice for the Kona Kai Ola development on the Island of Hawai'i and for your participation in the EIS process. Jacoby Development, Inc. (JDI) is striving to make Kona Kai Ola the first truly sustainable mixed-use development in Hawai'i. This process involves a very conscious effort to understand the workings of existing natural processes on the land and then to derive infrastructure plans that work with natural systems to the greatest extent possible. This is followed by the creation of a built environment meeting National Leadership in Energy and Environmental Design (LEED) standards that is, energy efficient, and entices people to walk more and drive less. Following are responses to the concerns raised in your EISPN comment letter dated August 4, 2006.

Geology, Topography and Soils

We fully recognize the unique characteristics of the site geology with its very porous and non-homogenous substructure. We could not locate the language you refer to in the General Plan or official County record indicating that would impact the reclassifications of the land use designations of this property from "Resort" to "Open" based on rock porosity, soil conditions or the presence of lava tubes. Our site planners do understand the potential problems associated with attempting to build a landscaped environment over porous lava. Initial plans to create a golf course were removed due in part to concerns about potential erosion and ground water contamination. While relatively small green space gardens will be associated with individual buildings, the intent is to leave the balance of the site as open natural lava landscaped with xeriscape native dry land plantings. Strongly limiting the quantity of soils imported will also limit the project's use of irrigation water, fertilizers, and pesticides.

Groundwater Hydrology and Water Quality

The potential for deterioration of the marine environment and impacts to the groundwater hydrology are major concerns for any coastal development. As the activities of this new development will be focused around the marine environment, particular attention is being paid to craft a community that sustains and protects the marine resources. Waimea Water Services (WWS) is in the process of completing a Site Geology and Hydrology survey that will clarify the present flow and quality of ground water in the area. The scope of work involves understanding the dynamics of groundwater chemistry and hydraulics in the vicinity of the proposed Honokohau Harbor expansion to accurately predict the impact of these ground water flows to the new harbor and the impact of the harbor on fresh water resources beneath adjoining properties. This information will be used by coastal engineers to model water flows in the new harbor and by marine biologists and oceanographers on the project team to both anticipate and propose mitigation for any adverse impacts to nearshore marine communities. These mitigations may result in changes to the project design that both improve its sustainability and reduce adverse impacts.

As an example of this process of continual design refinement, the developers of the project are considering using deep seawater as a coolant for air conditioning (SWAC) to reduce dependence upon electricity and in keeping with sustainability goals. Effluent from the deep seawater was initially planned to supplement flow to the surface lagoons and outfall to the harbor. However, it was brought to the attention of the planners that the high nutrient content of this water would likely cause excessive algae blooms in either the lagoons or in the nearshore waters outside the harbor. The initial plan has therefore been modified to include disposal of this water either through secondary off-site use or in a deep dispersion well with equivalent water quality. These waste flows will be incorporated into the development's wastewater treatment system.

Marine Resources and Endangered Species
Oceanic Institute in conjunction with AECOS Laboratory of Hawai'i, LLC is completing water quality testing and a Marine Biological Baseline Monitoring and Mitigation Plan. The plan is being conducted to determine the current conditions of water quality and aquatic resources and habitats within and adjacent to Honokohau Harbor, the proposed Kona Kai Ola site, and at sites potentially impacted by the proposed development. Potentially-affected aquatic resources and habitats including benthic and fish communities associated with nearshore coral reefs, recreational and commercial fisheries, endangered species, anchialine ponds and associated organisms, are being analyzed.

Coastal erosion is one of many issues that are, and will continue to be, monitored by the project team. Studies include review of historical data for the affected areas, field data collection, data analysis, reporting, discussion and evaluation of potential impacts associated with proposed development activities, changes in runoff, sedimentation and possible increases in pollution.

Oceanic Institute is completing a Marine Community Biological Survey to address the impacts to the marine ecosystem. A marine biological survey has been conducted to establish baseline conditions. Primary biological communities included in the surveys are:

- Biological communities in two clusters of natural anchialine ponds located north and south of the Honokohau Harbor entrance channel;
- Benthic communities along transects located at each of nine (9) offshore survey sites;
- Fish communities occurring within the nine (9) offshore survey sites;
- Benthic communities within Honokohau Harbor;
- Fish communities within Honokohau Harbor.

The frequency, location and scope of the proposed baseline surveys and analyses have been designed to incorporate the current requirements of local and federal permitting agencies, and

recognize the sensitive nature of adjacent areas, including the Kaloko-Honokohau Natural Historical Park and numerous popular dive and shoreline fishing sites.

Neither the project location nor the surrounding area is a federally-designated marine sanctuary. Further north along the coast of the Island of Hawai'i, is a federally-designated National Marine Sanctuary. The Hawaiian Islands Humpback Whale National Marine Sanctuary starts at Keahole Point and extends up to Kohala. However, just north of the Kona Kai Ola project site, is the Kaloko-Honokohau National Historical Park administered by the National Park Service (NPS).

Species diversity is being calculated for coral and algal communities using the Shannon-Weaver Index formula. A final report will include recommendations to address any impacts to the marine community. This report will be submitted along with terrestrial flora (**Robert W. Hobdy**) and fauna (**Rana Productions Ltd.**) reports.

The impact of the project on threatened or endangered species will be covered on a species by species basis, in the Draft EIS. Preliminary research indicates that there are no known terrestrial threatened or endangered species on the site. Species of primary interest that will be discussed individually in the Draft EIS include:

Humpback Whales;
Green and Hawksbill Sea Turtles;
Hawaiian Monk Seals;
Hawaiian Coot;
Hawaiian Stilt.

Impacts to other important marine species including sea birds, dolphins, and billfish will also be discussed in the Draft EIS. Impacts to the anchialine pond shrimp species and the potential for increased importation of alien invasive marine species on boat hulls, will also be discussed. The Kona Kai Ola team is completing the aforementioned studies in conjunction with the NPS to analyze and minimize potential adverse impacts to the marine ecosystem and water quality.

Archaeological and Historical Resources
Archaeological and cultural impact assessments are being completed by consultants as part of this project. Included in these is the analysis of any section of proposed roadway through Queen Lili'uokalani Trust property south of the main project location. All of the reports will be consistent with any applicable State provisions for methodology, consultation and input. The cultural impact assessment will include an analysis of cultural practices and resources. The value of on-site archaeological and cultural resources is being accommodated in the project design to preserve and enhance these resources wherever possible and appropriate. Each study will be included, in their entirety, as appendices of the Draft EIS, for public review and comment. Appropriate recommendations will be made as to mitigating any adverse impacts on these resources.

Roadway and Traffic
We concur with your assessment that traffic is a serious problem in Kona. The Kona Kai Ola development is being designed to minimize vehicle trips and increase alternative modes of transit

including walking. A traffic impact analysis is being completed as part of the Draft EIS. The traffic plan proposes improved access, widened intersections at Queen Ka'ahumanu Highway and the site, and most importantly, creation of an extension of Kealakehe Parkway to Kuakini Highway, parallel to Queen Ka'ahumanu Highway south into Kailua-Kona town. This is anticipated to relieve commuter congestion and provide an access way for visitors to the development, workers on the site, and commuters into town.

The idea with the Kona Kai Ola development is to create a community for work, lodging and recreation for visitors and residents of the area that is accessible by walking, biking, hiking, low impact transit shuttles, and boating. The project will be designed to be self-contained to the extent possible. This will minimize the need for vehicle travel and, combined with the roadway improvements, will help address the current traffic problems and any anticipated traffic impacts. Again, the full traffic analysis will be included in the Draft EIS for your review.

Affordable Housing
Affordable housing is a concern throughout Hawai'i and especially along the Kona coast. Under County Ordinance Chapter 11, Section 4 Affordable Housing Requirements, resort and hotel uses generating more than one hundred employees on a full-time equivalent basis must earn one affordable housing credit for every four full-time equivalent jobs created. This can be met by constructing affordable for-sale or rental units on site or within a 15-mile radius, providing developable land or paying in-lieu fees to the County housing agency. This and other provisions of the Housing Ordinance will be applied to the proposed Kona Kai Ola project during the rezoning stage for the project. JDI is already looking into various options to meeting housing ordinance requirements off site, including potential locations located mauka of the project site in the same or adjacent ahupua'a.

The eastern half of the project site is owned by DHHL. These lands are designated for commercial use in DHHL's Island of Hawai'i Plan. DHHL intends to use revenues from these commercial lands to fund homesteads further mauka and around the Island of Hawai'i.

Character of Community
As part of the Draft EIS, John M. Knox and Associates is completing a Social Impact Assessment. This assessment will analyze the impacts this project will have on the social fabric of the community with an emphasis on social and economic forces. Specifically, it will look at the potential future of the community with and without the project. The intent of this development is to preserve and/or recreate a Hawaiian sense of place through architecture, public access, amenities and preservation of cultural, historical and archaeological features of the site. Sustainability is a consistent theme throughout every aspect of the planned development. The concept of ahupua'a will be incorporated where possible.

Construction of the existing harbor and its first expansion were both accomplished through selective blasting and excavation. Moffatt & Nichol, the engineering firm tasked with the marina design, will develop a construction scenario that minimizes impact on the existing harbor and to coastal water quality while ensuring ample water circulation and boat traffic control during operation. All construction and earth movement will be required to comply with all Federal, State and County requirements for sound, air quality, building codes, and safety provisions as

well as all other applicable codes. All methodologies, results and conclusion will be assembled into a report for inclusion into the Draft EIS.

Thank you for your suggestion for an Ocean Marine Center as a facility at the site. Such a facility is tentatively being planned for the site. The marine center will provide an educational element for visitors and residents, while facilitating a respect for the environment and culture of the area. The cost of this facility would be borne by the developer.

Again, thank you for your input. If, following review of the Draft EIS, you have additional concerns or comments, we will welcome these comments in writing to our office. Your comment letter along with this response letter will be included as part of the Draft EIS.

Sincerely,

Jeff Metz, AICP
Senior Planner
Oceanit

August 5, 2006

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RECEIVED AUG - 8 2006

LATE
After close of comment period

Re: Jacoby Development Inc./Kona Marina Development LLC (HRS 343 FEA-EISPN)

Aloha mai,

I am requesting that I become a consulted party in the preparation of above referenced draft environmental impact statement (DEIS).

In addition, I would like to make the following comments:

POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT ON THE EXISTING NATURAL ENVIRONMENT

Geology, Topography, Soils Comment example: The geology, topography, and soils of the project area consist of very porous layers of lava rock with open lava tubes running from mountain to sea. The surface consists of rocky soils with little organic matter and vegetation. The Master Development Plan calls for a massive terra-forming of the project site from a low-nutrient, low-moisture environment into a high-nutrient, high-moisture one. The cumulative effect on the nearshore marine environment will be severely adverse. The addition of rich soils and extensive landscaping requiring heavy fertilization, watering, and pest control will result in high levels of nitrates, phosphates, and other nutrients percolating into the subterranean freshwater outflow. This will cause marine water pollution with substantial artificial increases over and above naturally occurring nutrient levels (see Comment example #4, Marine Resources).

Groundwater and Hydrology Comment example: Blasting a massive new inland marina and lagoon will substantially alter the second-largest freshwater outflow from Hawai'i's leeward coast which feeds and nourishes the pristine offshore coral reef environment. The impact of such alteration cannot be predicted. It is illegal to place an irreplaceable constitutionally-protected resource at unknown risk levels of irreparable harm.

Marine Resources Comment example #1: In March 2003, the Department of Health Deputy Attorney General testified in the Third Circuit Court that West Hawai'i's nearshore marine water quality had substantially deteriorated over the past ten years due to non-point pollution.

Comment example #2: Conclusion of Hokuli'a court-appointed water monitor in report dated August 2003, one month before project was shutdown for land use violation, "The water quality in nearshore coastal waters off Hokul'ia has obviously deteriorated since the third sampling in February 2003. Rainfall data from the rain gauge at Hokuli'a shows no significant rainfall for the three (3) month period (March-May 2003) proceeding the May 27, 2003 survey. There has been no increase in groundwater [out]flow or runoff to cause this increase in nutrients. The overall nutrient load decreases with distance from shore, so the marine environment is not causing this increase. We know that there has not been a massive increase in population in Kealakekua that could be contributing to the groundwater. So translocation of nutrients is not coming from up slope. However, both intensive watering, because of drought conditions, and establishment of golf courses and landscaping projects at the Hokuli'a development would result in nutrients percolating to the groundwater and flowing into the marine environment. We observed increased levels of nutrients, most strikingly, Total Dissolved Nitrogen in the waters off Hokuli'a compared to prior surveys. We conclude that the most likely source of these nutrients are the immediate Hokuli'a lands under construction."

Comment example #3: The Hokuli'a water monitor, Dr. Richard Brock, reported in December 2003, that glyphosphate (Roundup, Touchdown herbicide) had been found in 5 of 7 sediment samples taken from the previously pristine offshore coral reef environment.

Comment example #4: The Hokuli'a court-appointed water monitor tested ground wells above and below the Hokuli'a golf course and in April 2004 reported substantially elevated nitrate levels. The report concluded that golf course and landscaping activities were causing nearshore marine water nitrate levels that violated State Class AA water quality standards.

Natural Hazards

Botanical Resources

Wildlife Resources

Arthropod Resources (opihi, crabs, shrimp, lobster, plankton, etc.) Comment example: A local ninth-grade old student was one of the winners of a state science competition for her study of the affects of golf course runoff on shrimp. Her study concluded that toxins in golf course runoff were causing increased deaths in brine shrimp hatchlings and were likely causing the same effects in our nearshore marine waters.

Comment example #2: Nearshore landscaping activities are likely to generate the same amount, if not more, toxins than golf courses (see Comment example #2, Marine Resources).

POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT ON THE EXISTING HUMAN ENVIRONMENT

Archaeological and Historic Resources Comment example #1: The project area is directly adjacent to a national historical park. Board of Land and Natural Resources 9/23/05 meeting minutes transcript state: "Geri Bell, Superintendent of Kaloko-Honokohau National Historical Park that is on the north end of the harbor testified before the Board. Ms. Bell conveyed that the area was established as part of the national park system because of its rich cultural and natural resources. These resources include a heiau, petroglyphs, anchialine ponds and the endangered hawksbill turtle. Ms. Bell asked that these resources be protected. She spoke of her organizations desire to enter into an agreement or a lease to partner to protect these resources."

Comment example #2: At the 4/21/06 Planning Commission meeting, Jacoby consultant David Tarnas testified, "the idea is to connect from Kealakehe Parkway to Kuakini Highway and the route really depends on Queen Liliuokalani Trust. It's their land that has to be crossed and they have to consider burial sites and other archaeological sites." The coastal lands on either side of the Jacoby project area are similarly filled with nationally-recognized burial sites and other archaeological sites, then it is certain that the Jacoby project site has cultural resources of equal value and importance.

Cultural Impact Assessment (see pp. 47-48 of attached guidebook). Comment example #1: There are numerous current Native Hawaiian cultural practices within and adjacent to the proposed project area, including the practice of ho'oma'ema'e, or "cleansing". Destruction of such constitutionally-protected cultural and environmental resources will adversely impact constitutionally-protected cultural practices.

Roadways and Traffic Comment example #1: It is unlikely that the Kealakehe traffic relief envisioned by Jacoby will happen in our lifetimes. The Queen Liliuokalani Trust land, through which the Kealakehe Extension of the Core Infrastructure Plan must run, is presently zoned State Conservation Land Use District. State Land Use Commission approval is required before this area, filled with archaeological and historic sites, can be developed. As with Hokuli'a, the LUC process will likely take many years. Also, the Kona Community Development Plan has indicated the public wants this area to remain an open protected space. As with the Mamalahoa Bypass Highway, it could take many years of contested case hearings and/or other litigation before the Kealakehe Parkway extension will be completed, if ever.

Comment example #2: Four-laning Queen Ka'ahumanu Highway and the proposed additional

extension of Kealakehe Parkway to Kuakini Highway will not provide adequate traffic capacity in lieu of traffic to be created by already approved projects adding over 5,500 housing units in the area.
Comment example #3: Planned resort/transient population/tourist/commercial economic activities will result in traffic levels far in excess of permanent residential uses.

Noise

Air Quality

Visual Attributes Comment example: Scenic vistas are protected by Special Management Area regulation. The County has been allowing substantial increases in natural grade heights in developments between Queen Ka'ahumanu Highway and the coastline in violation of SMA regulation.

Socio-Economic Impacts

Social Impacts

Population

Housing Units Comment example: No affordable housing units are planned within the development. This will result in additional commuter traffic on already over-burdened road infrastructure.

Character of Community Comment example #1: The Department of Land and Natural Resources (DLNR) development agreement specifically excludes the Honokohau Small Boat Harbor, entrance channel, and boat launching ramps from the project. This will result in the existing local boating community being relegated to "ghetto" status relative to a new luxury marina subdivision, with the local boating community being forced to endure a huge increase in demands on an already overburdened harbor infrastructure. Local boating/fishing community opposes the proposed project.

Comment example #2: The Jacoby senior vice-president for environmental affairs has represented that the company will be promoting tour businesses and operators at Honokohau to encourage traffic for sales of their time-share units. This economic activity will forever alter the character of the Honokohau recreational/commercial boating community.

Comment example #3: The proposal calls for a marina and lagoon to be blasted in order to create open space for the local community, but the actual reason is to make the timeshares and hotel rooms more attractive for a transient residential population without regard to the character of the existing community..

Quality of Life

Economic Impacts Comment example #1: In the original Request for Proposal plan, Jacoby proposed 1,700 total units. That density has been increased to 2,500 units. Jacoby represented to the Board of Land and Natural Resources (BLNR) that the increase was necessary after it removed the golf course from its plan, "the design team needed to replace 225 acres with uses that would add value to the project". Clearly, the Jacoby design team has completely ignored the economic value of irreplaceable environmental and cultural resources located within the project area in its calculation, proving that Jacoby has little or no understanding of the public resources the project will impact. Jacoby represented to the BLNR that the increased density was necessary because it had substantially underestimated the cost of infrastructure improvement. This admission by Jacoby calls into question the accuracy of representations that allowed the developer to obtain its lease agreement with the Department of Hawaiian Home Lands and the development agreement with BLNR.

Comment example #2: Increasing the number of boat-slips from 200 to over one thousand would overwhelm the small harbor entrance and already overburdened, dilapidated infrastructure at Honokohau. Proposed marina expansion far exceeds current demand for boat-slips.

Comment example #3: There already exists a huge economic/lifetime potential cost to the community caused by the additional 20,000+ vehicle trips that will result from planned development near the proposed project area.

Employment, personal income, consumer expenditures Comment example: Irrelevant given the low unemployment/high cost-of-living environment in Kona.

Fiscal Impacts/Government Revenues Comment example: Short- and long-term socio-economic cost to public caused by irreparable harm to environmental/cultural resources and cost of lost of time and quality of life caused by additional vehicular and boat traffic exceeds short-term profits and future revenues.

Public Infrastructure

Traffic Circulation Comment example: The Keahole-to-Honaunau Regional Traffic Circulation Plan (May 2003) concluded that Kona traffic would become gridlocked by the year 2020 even if all planned roadways and road expansions are constructed within this timeframe. The report was issued prior to the approval of Palamanui and several other large developments in Kona. Therefore, it should be presumed that Kona traffic will become gridlocked much sooner than calculated by the K-to-H Traffic Plan.

Potable Water System Comment example: County Council member Angel Pilago, representing District 8 in which the proposed project is located, testified before the BLNR on 9/23/06 that there was insufficient potable water for the development.

Irrigation System

Wastewater Facilities Comment example: The Kealakehe Waste Water Treatment Plant, adjacent to the proposed development, has been given an unacceptable rating by the Department of Health for a number of years because the secondary treatment effluent is being poured into a pit that percolates into the second largest freshwater outflow on the leeward coast of Hawai'i. Boaters on the coastline makai of the mauka effluent disposal site have reported a strong sewage smell associated with observations of brownish marine water.

Storm Drainage

Solid Waste Collection and Disposal

Electrical and Communications Systems

Public Services Comment example: Lease by National Park Service will result in greatest benefit to public services.

Schools

Police

Fire Protection

Health Care

Recreation Facilities

RELATIONSHIP OF THE PROPOSED DEVELOPMENT TO STATE AND COUNTY PLANS, POLICIES, AND CONTROLS

Hawai'i State Plan Comment example #1: Perhaps the most disturbing aspect of the proposed Jacoby project is that it is the State DLNR which seeks to develop the Honokohau Harbor area to "maximize the returns…to the developer and the state". Jacoby's development plan calls for a massive terra-forming of the project site within a dysfunctional governmental regulatory environment. For instance, the State has turned a blind eye even as the water quality of West Hawai'i's nearshore marine environment has significantly deteriorated and as irreplaceable cultural sites are forever obliterated by a dysfunctional, impotent State Historic Preservation Division. The State and the Department of Hawaiian Home Land (DHHL) Request for Proposals asked for a private company to come forth and engage in an illegal development of the Honokohau Harbor area. This fact is proven by the County's approval of Rutter's nearshore golf course at Kohanaiki with the County SMA, despite the results of the Hokuli'a court-appointed water monitor and testimony by the Department of Health's Deputy Attorney General that prove nearshore development is polluting nearshore marine water.

Comment example #2: 9/23/05 meeting minutes: "Rep. Cindi Evans pointed out attorney's at the legislature have looked at the submittal and have noted that Hawai'i Revised Statutes Chapter 171 requires the Department of Land and Natural Resources to seek approval from the Legislature for the disposition of State property if 1) it involves using State land and allowing a private developer to develop the land; 2) dealing with submerged lands and 3) if a resort component is involved in the development."

Conservation Lands Comment example: Proposed Master Development Plan focusing on transient residential/tourist activities will place additional burden on State Conservation Lands

Employment Comment example: Irrelevant given current lack of available workers in Kona.

Energy

Health Comment example: from *Scientific American, "Wading in Waste", July 2005*, "The predominant terrain in the [Florida] Keys is karst topography - the underlying soils consist primarily of limestone, with many cracks an sinkholes caused by erosion. This geologic formation is very porous and hence cannot effectively filter the bacteria-rich effluent from septic tanks. In

1995 a research team led by John H. Paul and Joan B. Rose of the University of South Florida found that fecal microbes from septic systems in the Keys readily pass through the soil and can enter the coastal waters near the shore within hours…Microbial pollution also poses a serious danger to people involved in common recreatioinal activities such as swimming, surfing, wading, diving, snorkeling, waterskiing, and boating. If fecal organisms contaminate streams or seashore, anyone in the water risks infection by microbes entering through the mouth, nose, eyes, or open wounds. Some of the illnesses caused by water contact include gastroenteritis, conjunctivitis (eye infection), cellulites (skin irritation such as swimmer's itch), ear infections, respiratory infections and more serious diseases such as hepatitis and Guillain-Barre syndrome, an inflammatory disorder of the peripheral nervous system that can induce paralysis...To protect America's coastal waters, developers and builders need to move away from their current destructive practices - including clear-cutting, wetlands drainage, and extensive use of pavement." In Hawai'i, bulldozing equates to clear-cutting. The state and county's use of drywells to redirect surface water into the subterranean environment does not mitigate nearshore pollution given the hydrology and geology of the leeward Hawai'i coastal environment.

Historic Preservation Comment example: The State Historic Preservation Division was slammed in a legislative audit in 2003 which resulted in the resignation of its director, Don Hibbard. There have been allegations of new irregularities and violations of Hawai'i Administrative Rules at SHPD in the past few months. For instance, at the end of last month, the new director, Melanie Chenin, signed off on a Preservation Plan for Stanford-Carr's Kaloko Heights development even though the Hawai'i Island Burial Council has not approved the Burial Treatment Plan. The plan grants Stanford-Carr's request to destroy its portion of the ancient "Road to the Sea" trail that runs from the Kaloko-Honokohau National Historical Park and mauka Mamalahoa Highway. The National Park and Na Ala Hele, the State trails authority had asked that the trail be preserved. The last Kona Community Development Plan public workshop had designated this trail and the area surrounding the trail as a protected mauka-makai open, protected green space. Yet Chenin is reported to have signed Stanford-Carr's grubbing permit on July 13, 2006. There is insufficient government oversight and enforcement of historic preservation laws to ensure that the significant and numerous historic preservation sites on the Jacoby project site will be protected in perpetuity.

Housing

Human Services

Recreation

Tourism Comment example: Local economy already too dependent upon tourism. Proposed project increases economic risk.

Transportation

County of Hawai'i

General Plan Comment example: Testimony of Planning Director Christopher Yuen at 4/21/06 Planning Commission hearing of proposed interim General Plan amendment to change Jacoby project area from Open to Urban: "At the moment, my position is opposed to that [Jacoby's request for Resort zoning in the project area]. And their specific proposal is for something like 1500 to 2000 timeshare units at, in the Honokohau area, which I think, given the present growth situation in the Kailua-Kona [area], the housing deficit, the traffic problem. I would not support a growth generating development of that nature…So that's the issue and I'm, as I said, I'm not at the moment inclined to initiate a change to Resort to have a resort at Honokohau Harbor for the reason I just stated." When the Planning Director Yuen was later asked by a Planning Commissioner "…is the National Park comfortable with expanding the Urban area, you know, up to the National Park boundary?", Yuen replied, "I don't think we specifically went to the National Park with this General Plan amendment."

Kona Community Development Plan Comment example: KCDP public process has deemed Jacoby project area to be protected open space. The Queen Liliuokalani Trust land to the south is in the State Conservation Land Use District and the Kaloko-Honokohau National Historical Park is to the immediate north.

Zoning Comment example: Urban expansion zoning in nearshore environment is proving to be illegal, given impacts to environmental and cultural resources.

Special Management Area (SMA) Comment example: It will be legally impossible for the BLNR to find that the Jacoby development will not have any substantial adverse environmental or ecological effect. The adverse effect cannot be practicably minimized to a level that clearly outweighs public health, safety, or competing public concerns. The cumulative adverse effects and impacts of individual developments on the West Hawai'i coast, including the proposed Jacoby project, are causing irreparable harm to the public's constitutionally-protected environmental and cultural resources. Under existing law, no further nearshore development should be legally approved within the West Hawai'i nearshore lands. The State, County, and private sector should take immediate action to mitigate the adverse environmental impacts of existing nearshore resort, residential, commercial, and golf course development.

ALTERNATIVES TO THE DEVELOPMENT

The Preferred Alternative Comment example: Allow the National Park Service to lease the DLNR and DHHL properties as requested.

Other Alternative Comment example: Use revenues collected by DLNR through small harbor use economic activities to fund needed improvements.

No-action Alternative Comment example: Honor the KCDP public request to keep the project area open and protected.

Alternative Location for the Proposed Project Comment example: The KCDP has determine that all future development north of Kailua-Kona is to be above Queen Ka'ahumanu Highway.

CONTEXTUAL ISSUES

Relationship between short-term issues and Maintenance of Long-term Productivity

Irreversible and Irretrievable Commitments of Resources

Offsetting Considerations of Governmental Policies

Potential Unavoidable Adverse Environmental Affects

Potential Adverse Effects on Public Services and Facilities

Unresolved Issues

Sincerely,

Scott Gorrell
64-5215 Nani Waimea St.
Kamuela, HI 96743
ryanscottg@yahoo.com

oceanit
innovation through engineering & scientific excellence

October 20, 2006

Scott Gorrell
64-5215 Nani Waimea Street
Kamuela, Hawai'i 96743

Dear Mr. Gorrell:

Thank you for your comments to the EIS Preparation Notice for the Kona Kai Ola development on the Island of Hawaii and for your participation in the EIS process. The developers of the Kona Kai Ola project are striving to make this the first truly sustainable mixed-use development in Hawaii. This process involves a very conscious effort to understand the workings of existing natural processes on the land and then to derive infrastructure plans that work with natural systems to the greatest extent possible. This is followed by the creation of a built environment meeting National Leadership in Energy and Environmental Design (LEED) standards that is easy on the surrounding ecology, energy efficient, and entices people to walk more and drive less. We hope to set a new standard in the way developments relate to the surrounding natural and social environment to create long term sustainable communities. Following are responses to concerns raised in your comment letter dated August 5, 2006. Professional consultant studies are currently being completed as part of the Draft EIS which will provide detailed information for many of the concerns expressed in your letter. These will be included as attachments to the Draft EIS for your review.

Geology, Topography and Soils
We fully recognize the unique characteristics of the site geology with its very porous and non-homogenous substructure. To create additional harbor space as required by the DLNR agreement, the project will remove approximately 2 million cubic yards of material over an area of about 45 acres. Additional lava will be removed from around the harbor and beneath the planned shore-side lagoons to terrace these in an aesthetic manner towards the new harbor. This will create a marina and lagoon area that is accessible and user friendly. The current plan is that all of the excavated material will be re-used on site during construction.

Site planners understand the potential problems associated with attempting to create a landscaped environment over porous lava. Initial plans to create a golf course were removed due in part to concerns about potential erosion and ground water contamination. While relatively small green space gardens will be associated with individual buildings, the intent is to leave the balance of the site as open natural lava landscaped with appropriate xeriscape native dry land plantings.

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Strongly limiting the quantity of soils imported will also limit the project's use of irrigation water, fertilizers, and pesticides.

Groundwater Hydrology and Water Quality
The potential for deterioration of the marine environment and impacts to the groundwater hydrology are major concerns for any coastal development. The activities of this new development will be focused around the marine environment. We are paying particular attention to crafting a community that sustains and protects the marine resources. Waimea Water Services (WWS) is in the process of completing a Site Geology and Hydrology survey that will clarify the present flow and quality of ground water in the area. The scope of work involves understanding the dynamics of groundwater chemistry and hydraulics in the vicinity of the proposed Honokohau Harbor expansion to accurately predict the impact of these ground water flows to the new harbor and the impact of the harbor on fresh water resources beneath adjoining properties. This information will be used by coastal engineers to model water flows in the new harbor and by marine biologists and oceanographers on the project team to both anticipate and propose mitigation for any adverse impacts to nearshore marine communities. These mitigations may result in changes to the project design that both improve its sustainability and reduce adverse impacts.

Impacts to Marine Resources (Including Arthropods)
Oceanic Institute in conjunction with AECOS Laboratory of Hawai'i, LLC is completing water quality testing and a Marine Biological Baseline Monitoring and Mitigation Plan. The plan is being conducted to determine the current conditions of water quality and aquatic resources and habitats within and adjacent to Honokohau Harbor, the proposed Kona Kai Ola site, and at sites potentially impacted by the proposed development including increased runoff and drainage. Potentially-affected aquatic resources and habitats including benthic and fish communities associated with nearshore coral reefs, recreational and commercial fisheries, and anchialine ponds and associated organisms, are being analyzed.

The study includes review of historical data for the affected areas, field data collection, data analysis, reporting, discussion and evaluation of potential impacts associated with proposed development activities, changes in runoff, sedimentation and possible increases in pollution. Biota monitoring have been performed in each of the ponds located within or immediately adjacent the project site

The frequency, location and scope of the proposed baseline surveys and analyses have been designed to incorporate the current requirements of local and federal permitting agencies, and recognize the sensitive nature of adjacent areas, including the Kaloko-Honokohau Natural Historical Park and numerous popular dive and shoreline fishing sites. Water quality in harbor and nearshore environments is being linked to groundwater quality data collected by project hydrologists.

Oceanic Institute is completing a Marine Community Biological Survey to address the impacts to the marine ecosystem. A marine biological survey has been conducted to establish baseline conditions. Primary biological communities included in the surveys are:

- Biological communities in two clusters of natural anchialine ponds located north and south of the Honokohau Harbor entrance channel;
- Benthic communities along transects located at each of nine (9) offshore survey sites;
- Fish communities occurring within the nine (9) offshore survey sites;
- Benthic communities within Honokohau Harbor;
- Fish communities within Honokohau Harbor.

Archaeological, Historical and Cultural Resources
The development team is cognizant of the on-site cultural resources and has hired both archaeological and cultural resource experts to catalogue these resources and develop an approved plan of action. Flora, fauna, archaeological, and cultural impact assessments are being completed by consultants as part of this project. Included in these is the analysis of the proposed roadway through Queen Lili'uokalani Trust property south of the main project location. All of the reports will be consistent with any applicable State requirements for methodology, consultation and input. The cultural impact assessment will include an analysis of cultural practices and resources. Each study will be included, in their entirety, as appendices of the Draft EIS, for public review and comment. Appropriate recommendations will be made as to mitigating any adverse impacts on these resources.

Jacoby Development, Inc. (JDI) and various consultants have been in contact with DLNR's Office of Conservation and Coastal Lands, to discuss creation of trails as part of the project. The area along the shore is zoned "Conservation", and the uses are limited. Various State agencies with oversight of the Conservation zone are looking at trail uses, passive public access features and natural restoration.

Roadway, Traffic, Noise and Air Quality Concerns
The acknowledgement of existing traffic problems in Kona has been a key consideration in the design of Kona Kai Ola. A traffic impact analysis is being completed as part of the Draft EIS. The traffic plan proposes improved access, widened intersections at Queen Ka'ahumanu Highway and the site, and most importantly, creation of an extension of Kealakehe Parkway to Kuakini Highway, parallel to Queen Ka'ahumanu Highway south into Kailua-Kona town. This is anticipated to relieve commuter congestion and provide an accessway for visitors to the development, workers on the site, and commuters into town. The idea with the Kona Kai Ola development is to create a community for work, lodging and recreation for visitors and residents of the area, which is accessible by walking, biking, hiking, low impact transit shuttles, and boating. The project will be designed to be self-contained to the extent possible. This will minimize the need for vehicle travel and, combined with the roadway improvements, will help address the current traffic problems and any anticipated traffic impacts. Again, the full traffic impact assessment report will be included in the Draft EIS for your review. In conjunction with the traffic study, air quality and noise studies are being completed. The noise study will look at both construction noise and ongoing noise changes due to the new development. These studies will be included in the Draft EIS.

Visual Impacts
The *Hawai'i County General Plan* characterizes the scenic beauty of various areas and identifies sites and vistas of natural beauty. Although the subject property is not specifically listed as an

example of natural beauty within the Kona districts, the general view plane extending mauka and makai from Queen Ka'ahumanu Highway is identified as such a site. The large geographical area within this view plane includes the project site. Due to its location within the Queen Ka'ahumanu Highway view plane, the project has the potential to impact public views of the coastline in this area of North Kona.

The Draft EIS will evaluate scenic impacts of the project through a comparison of current scenic character from various vantage points with those expected after the project is constructed. Mitigation for such impacts will be discussed which may include various design principles including massing and height limitations.

Social Impacts, Housing and Community Quality of Life and Character
As part of the Draft EIS, John M. Knox and Associates is completing a Social Impact Assessment. This assessment is analyzing the impacts this project will have on the social fabric of the community with an emphasis on social and economic forces. Specifically, it is looking at the potential future of the community with and without the project. The intent of this development is to maintain a Hawaiian sense of place through architecture, public access, amenities and preservation of cultural, historical and archaeological features of the site. Sustainability is a consistent theme throughout every aspect of the planned development. The concept of a*hupua'a* will be incorporated where possible.

Affordable housing is a concern throughout Hawai'i and especially along the Kona coast. Under County Ordinance Chapter 11, Section 4 *Affordable Housing Requirements*, resort and hotel uses generating more than one hundred employees on a full-time equivalent basis must earn one affordable housing credit for every four full-time equivalent jobs created. This can be met by constructing affordable for-sale or rental units on site or within a 15-mile radius, providing developable land or paying in-lieu fees to the County housing agency. This and other provisions of the Housing Ordinance will be applicable to the proposed Kona Kai Ola project. JDI is already looking into various options to meeting housing ordinance requirements, including developing workforce housing on lands mauka of the project site in the same or adjacent ahupua'a.

The eastern half of the project site is owned by DHHL. These lands are designated for commercial use in DHHL's Island of Hawai'i Plan. DHHL intends to use revenues from these commercial lands to fund DHHL homestead projects further mauka and around the Island of Hawai'i. When full requirements for meeting affordable housing are determined and codified at the rezoning process, a full review of the impacts will be analyzed under environmental review provisions of Chapter 343.

Construction of the marina is also a mandate by the State in order for JDI to be allowed to develop the site. The developer is required to construct an 800 slip marina. The marina will feature modern, well-designed facilities within the design parameters of a master planned development. This will ensure organized development, consistent design requirements, and comprehensive phased planning of the site.

Economic, Government and Employment Impacts
An economic analysis currently being completed as part of the Draft EIS will analyze the visitor industry economics including occupancy rates for the West Hawai'i visitor market and the full range of market conditions. In addition, a marina traffic study is currently looking at the valid concern of movement of boat traffic, boat safety and impacts from additional boats in the harbor entrance. This report and recommendations will be included in the Draft EIS.

The Draft EIS is required to review impacts to government services such as schools, police and fire, health care, recreation, and on the increased need for housing and services as a result of increased employment at the proposed development. This project is being reviewed by all relevant County and State agencies. Appropriate recommended mitigations by those agencies, based on their review of the Draft EIS, will be included as part of the Final EIS.

Infrastructure
All natural resource requirements and infrastructure needs of this development (potable and irrigation water, sewer, solid waste, roads, electricity, etc.) is being analyzed as part of the Draft EIS. This project is contiguous to Hawai'i County's Kealakehe Wastewater Treatment Plant. This plant is located south of the existing harbor and proposed project. Based on County of Hawai'i Department of Environmental Management - Wastewater Division maps (updated October 2005), the project area is "planned to have sewer service in 10 years". The developer will be required by the County to upgrade the wastewater facilities to handle the additional flow to the plant, and to construct a wastewater system designed to meet County standards.

The Hawai'i County Department of Water Supply, or DWS, provides and maintains various public water systems on the Island of Hawai'i. The proposed project is located within the DWS North Kona System, which is supplied by a total of nine wells and one shaft. An existing waterline is present along Queen Ka'ahumanu Highway. It is anticipated that the project non-potable water facilities, such as irrigation, will ultimately connect to the County's proposed effluent reuse system. At this time, exact water needs are not known and available water allocations commitments from DWS have not been made. The Draft EIS will analyze the water needs of the project, water allocations from the County and mitigation such as conservation, water recycling and other technologies to reduce the amount of water that the project requires, consistent with industry sustainability goals.

State and County Plans, Policies and Permits
Consistency and compliance with State and County plans and policies was briefly discussed in the EISPN and will be expanded upon in the Draft EIS. While the area has a State Land Use designation of "Urban", a General Plan Amendment (GPA) approval is still required for a portion of the property from "Open" to "Urban Expansion". This GPA request is currently being considered by the Hawai'i County Council. If and when that is approved, the development requires numerous permits and public reviews. A rezone of the property from "Open" to an appropriate designation for the development, would be required, in addition to State and Federal permits and approvals, a CDUA permit will be required to be issued through DLNR Office of Conservation and Coastal Lands, and an SMA permit will be required to be issued through the County of Hawai'i. Consistency with County Plans, State requirements and all applicable regulations, will all be reviewed as part of these permits. If and when the Kona Community

Development Plan is approved, this project will be reviewed against its policies as well. Subsequent required permits may stipulate various conditions as part of any approval which would be designed to mitigate impacts from this development.

The developer has been working closely with the National Park Service to share information, provide joint testing and research results, and to address concerns raised by that agency related to this project's impacts on the Kaloko-Honokohau National Historical Park. The developer, DLNR and DHHL have also been working with Queen Lili'uokalani Trust to gain their consensus on the need for this road and its placement through their lands.

Alternatives
The agreements and leases between the State and JDI stipulate the general parameters of development for the site in terms of uses, quantities and size of many features, with the focus on the marina. Unlike a private property project, JDI is required to meet the criteria outlined in the agreements, thereby affording less flexibility in options and uses. The developer was chosen by both DHHL and DLNR for the implementation of a coordinated development plan on these two sites. The DLNR intent for initiating this project is to provide revenues for DLNR through the leasing of its property for this development, along with expansion of the marina facilities at this site. The DHHL hopes to generate revenues from its site to fund development costs for Hawaiian Homes on other DHHL lands. In the absence of this agreement for coordinated development, it is likely that each entity would take different paths towards implementing their independent goals.

Again, thank you for your input. If, following review of the Draft EIS, you have additional concerns or comments, we will welcome these comments in writing to our office, the applicant, and the Office of Environmental Quality Control. Your comment letter along with this response letter will be included as part of the Draft EIS.

Sincerely,

Jeff Merz, AICP
Senior Planner
Oceanit

United States Department of the Interior
NATIONAL PARK SERVICE
Kaloko-Honokohau National Historical Park
73-4786 Kanalani St., Suite 14
Kailua-Kona, HI 96740

IN REPLY REFER TO:
L7621

August 18, 2006

RECEIVED
AUG 21 2006

Mr. Scott Condra
Jacoby Development, Inc.
Kona Marine Development LLC,
171 17th St., NW Ste 1550
Atlanta, Georgia 30363

RE: Kona Kai Ola Environmental Impact Statement Preparation Notice

Dear Mr. Condra:

The National Park Service appreciates the opportunity to provide these comments on the Kona Kai Ola Environmental Impact Statement Preparation Notice (EISPN). Kaloko-Honokohau National Historical Park adjoins the northern boundary of the proposed Kona Kai Ola development and harbor expansion (see attached figure), and we are concerned about the negative impacts a development of this scale is likely to have on the area's cultural, terrestrial and marine resources. We request that the National Park Service (NPS) be a formally consulted party during the EIS process. The NPS has already been informally consulted a number of times through meetings with cultural and natural resource staff and we appreciate the efforts at communication made by Jacoby Development Inc (JDI). When requested, we have provided scientific data from NPS studies on park resources, including groundwater, water quality, oceanography, cultural resources, and anchialine pools to JDI.

The National Park was authorized by Congress in 1978 to preserve and perpetuate traditional native Hawaiian activities and culture (Public Law 95-625). The authorization was based on the study and recommendation of a congressional advisory commission made up of native Hawaiians. That commission recommended that the area previously designated "Honokohau Settlement National Historical Landmark (1962)" and adjacent waters be preserved for the benefit of the Hawaiian people and the nation as part of the national park system.

The congressionally legislated Park boundary includes 7.5 acres of State of Hawaii lands on the northern side of Honokohau Harbor and 15.5 acres of State of Hawaii lands to the south of the Honokohau Harbor entrance (see attached figure). The National Park Service has a lease agreement with the State of Hawaii for the 7.5 acres on the northern side of the harbor channel; unfortunately, the NPS has been unable to lease the authorized lands on the southern side of the harbor. These lands are included in the current project area as specified in the EISPN.

The U.S. Congress included this southern parcel within the Park's legislated boundaries because it contains several significant cultural sites including the Maka'opio heiau, Hale o Lono heiau, and other archeological features, as well as 19 known anchialine pools. In the 1962 National Survey of Historic Sites and Buildings for the Honokohau Settlement National Historical Landmark, the pristine and significant cultural values of these lands are described as follows:

> "...at Alaula cove is a fisherman's heiau, remarkable for two great upright stone slabs which rise above the height of the pavement in its seaward retaining wall. These slabs served as fishermen's gods. It lies in a most picturesque setting of clear, emerald-green bathing pools at the rear, is surrounded by ancient house sites, and is adjacent to a coral–sand beach at the head of a protected cove. The area from this cove over to and including the heiau of Puuoina seems to have the potentials [*sic*] for a superb and unique park which could at the same time preserve the most characteristic features of ancient Hawaiian coastal settlement."

The National Park Service believes that the best protection and preservation for these unique and nationally significant cultural and natural features lies in allowing them to become a part of Kaloko-Honokohau National Historical Park.

The EISPN does not mention that approximately 15.5 acres of the proposed project area were authorized by the U. S. Congress to be part of the National Park, and their inclusion in the Honokohau Settlement National Historical Landmark. Section 1.4, Figure D does show the congressionally legislated boundary of the Park but does not explain that the area is not currently protected by the NPS. Section 3.9.3 and Figure M also confuses the authorized boundary with land jurisdiction. The State of Hawaii maintains jurisdiction over Park waters.

The proposed project will result in the destruction of the anchialine pools described in the National Historical Landmark document above. The excavation of the enlarged harbor basin, as described in the ESIPN, will likely cut off fresh groundwater flow to the pools, thereby raising the salinity in the pools to a level that will prohibit the survival of the endemic anchialine pool ecosystem. The NPS is opposed to the destruction/degradation of these pools.

In 2004, data from biological surveys of these pools by the U.S. Geological Survey Biological Resources Division and the NPS Inventory and Monitoring Program recorded two species listed by the U.S. Fish and Wildlife Service as Candidate Endangered Species inhabit the pools. These species are the orangeblack Hawaiian damselfly *Megalagrion xanthomelas* and the anchialine pool shrimp *Metabetaeus lohena*, a carnivore that preys on the non-endangered red opae'ula, *Halocairdinia rubra*. A thorough examination of impacts to the pools and candidate species is needed.

The EISPN does not contain a section for threatened and endangered species or for protected marine species. These sections must be included in the DEIS to address potential impacts to hawksbill and green sea turtles and marine mammals including Hawaiian spinner dolphins and the Hawaiian monk seal from increased boat traffic, noise, and added pollutants. Of these, green sea turtles and spinner dolphins use Honokohau bay and the harbor entrance on a daily basis.

Hawksbill sea turtles are regularly sighted at dive sites on both sides of the harbor entrance. Monk seals have been recorded in the Park several times since 2001.

The EISPN does not contain a section analyzing impacts to the National Park, local environment, and economy from the introduction of alien marine invasive species that will occur with enlarging the harbor boat capacity and promoting it as a yachting destination. Alien invasive marine species are a significant problem in Hawaii, causing both economic and environmental harm in several parts of the state.

In the Proposed Action, the project objectives describe a long-term lease, which creates no incentive for long term sustainability. The DEIS should also consider impacts that will occur at the end of the lease period.

Additionally, the Proposed Action states a minimum expansion of the harbor basin to 800 slips and no less than 45 acres. This expansion is a 300% increase in the current harbor capacity. It is not clear in the EISPN on what data the State of Hawaii based this requirement. Will lesser expansion be analyzed? The NPS questions whether the harbor channel and natural resources in the area can safely and adequately sustain this density of boats and their associated impacts.

The EISPN mentions a shoreline park in the area encompassed by the National Park's legislated boundary, which includes a 400 foot buffer. It is unclear in the language of the EISPN whether "buffer" means that no development such as roadways, paved bike paths, restroom facilities or utilities trenching will occur within the buffer, or if such infrastructure will be allowed. Development of such infrastructure within the buffer will dilute the integrity of, and potentially destroy, the cultural and archeological features of the ancient Honokohau Settlement area. Specific uses and actions in the buffer and their direct and indirect impacts should be discussed fully in the DEIS.

Water resources in Kaloko-Honokohau National Historical Park are significant cultural and natural resources. The Park contains two large (>15 acre) fishponds, more than 130 known anchialine pools and 596 acres of marine waters. Significant water withdrawals from the surrounding area water table for lagoons, irrigation and other site purposes could have major direct and cumulative impacts on the Park's anchialine pools and Hawaiian fishponds, and on submarine groundwater discharge. Increased water withdrawals will likely raise the salinity of the groundwater in the area and may interfere with species dependent on these habitats such as the anchialine pool species already mentioned, and the endangered waterbirds, the Hawaiian stilt (*Himantopus mexicanus knudseni*) and Hawaiian coot (*Fulica alai*), which use the brackish Aimakapa Fishpond and wetland for breeding. A full analysis of this potential impact to the Park's water resources should be discussed in the DEIS.

Non-point source pollution from constructed impermeable surfaces, particularly those in light industrial parks, added nutrients from irrigation and fertilizing greenspaces, and pollutants from certain industrial park businesses are a significant concern of the National Park Service. We suggest that JDI examine and adopt the conditions formulated by the Hawaii Land Use Commission in the Findings of Fact, Conclusions of Law and Decision and Order for Docket A00-732 (February 2002), for a light industrial development directly upslope of the National Park. These conditions were designed by the commission specifically to protect the National

Park's resources from non-point source pollution. We also suggest that the DEIS include an analysis of construction techniques beyond what are required by the county and state, such as permeable parking lots and other "green construction," to reduce non-point source pollution to the groundwater and marine waters.

The NPS is also concerned about other aspects of the project including impacts to the viewscape from the National Park, which is not mentioned in Section 4.3. The EISPN does mention the potential impacts to the Park from increased noise. Mitigation of noise at the harbor entrance near areas of the Park where cultural practices regularly occur should be examined. Air quality, Section 3.5, is also a concern and local air patterns are not adequately described. The prevalent wind system in the project area is mauka – makai, nighttime and morning offshore winds changing to onshore during the day. Poor air quality resulting from volcanic emissions, airport emissions, highway traffic emissions, and fugitive dust from quarries above the harbor and construction is not readily moved away from the area. Trade winds are not prevalent. Cumulative impacts from the construction of this project in conjunction with the highway expansion and multiple industrial park construction in the area must be examined. As the area is increasingly becoming a population center, air quality and human health become important issues.

The National Park Service appreciates the efforts of Jacoby Development Inc and its consultants thus far in communicating with Park staff on issues raised by the proposed project. We anticipate that this level of communication will continue as the Environmental Impact Statement is prepared.

Sincerely,

ACTING SUPERINTENDENT

FOR Geraldine Bell,
Superintendent

cc: Board of Land and Natural Resources
Jeff Merz, Oceanit
Office of Environmental Quality Control

oceanit.
Innovation through engineering & scientific excellence

October 20, 2006

Geraldine Bell, Superintendent
United States Department of the Interior
National Park Service
Kaloko-Honokohau National Historical Park
73-4786 Kanalani Street, Suite 14
Kailua-Kona, Hawai'i 96740

Dear Ms. Bell:

Thank you for your comments to the EIS Preparation Notice for the Kona Kai Ola development on the Island of Hawai'i and for your participation in the EIS process. Your park staff headed by Dr. Sallie Beavers has been a continual source of valuable information based upon sound scientific investigations conducted at the park. We feel confident that this additional information will assist us in designing a development that has minimal adverse impact and benefits both the local community and the adjacent National Park.

Because of the unique location of the project adjacent to the National Park, an existing and expanded harbor, and a culturally and ecologically sensitive coastline, the developer has mandated that the project will follow sustainability guidelines. The Kona Kai Ola development will aspire to be the first Low Impact Design, LEED certified sustainable development in Hawai'i. This process involves a very conscious effort to understand the workings of existing natural processes on the land and then to derive infrastructure plans that work with natural systems to the greatest extent possible. This is followed by the creation of a built environment that is appropriate to the surrounding ecology, energy efficient, and entices people to walk more and drive less. With the help of concerned community members and responsible scientists we hope to set a new standard in the way developments relate to the surrounding natural and social environment to create long term sustainable communities. Your efforts towards this goal are appreciated.

The National Park Service - Kaloko-Honokohau National Historical Park will be included and referenced in the Draft EIS as a consulted party. Your comments will be addressed and will be incorporated into the Draft EIS for the Kona Kai Ola project. A copy of the Draft EIS will be sent to you for review and comments. The format of this response letter does not allow for complete answers to all of your questions and concerns. Our consultant team is presently researching the various challenges relating to this development and their efforts will be documented in the Draft EIS. Our initial responses to your concerns raised in your letter dated August 18, 2006, are included below.

1. *National Park Service Boundary and Jurisdiction*

The Draft EIS will clarify and elaborate on the difference between the Congressionally-legislated boundary of Kaloko-Honokohau National Historical Site (NHS) and the actual land jurisdictional boundaries of the NHS. The Draft EIS will explain why the U.S. Congress included the area south of the existing harbor channel entrance and how it contains significant cultural sites.

Dr. Alan Haun and Associates is completing the archaeological inventory for the DLNR portion of the project area. **Dr. Taupouri Tangaro** is completing the Cultural Impact Assessment for this site and the surrounding cultural significance of the area. These two studies will be combined with the existing archaeology and cultural studies for the area to provide a comprehensive review of the impacts this project will have. All will be included as part of the Draft EIS.

The archaeological studies involve background review and research, consultation with appropriate cultural representatives regarding culturally significant sites and subsistence use of the area, a full pedestrian reconnaissance survey, detailed recording of all potentially significant properties including scale plan drawings, written descriptions, and photographs and subsurface testing at selected sites. Upon completion of fieldwork, Dr. Alan Haun and Associates will prepare and submit a site location map and list of sites with tentative significance assessments and recommended treatments along with a survey report for the Draft EIS, in conformance with regulatory agency requirements (including State Historic Preservation Division (SHPD)) for inventory survey reports. The report would include significance assessments and specific recommendations for any further archaeological work that might be required. Dr. Alan Haun and Associates will submit a final report to Oceanit formally addressing any comments from DLNR-SHPD and public comments from the Draft EIS.

2. *Water Resources, Withdrawals, Salinity and Non-Point Source Pollution*

Consultants are in the process of completing coordinated studies to analyze the environmental concerns expressed in your letter.

Waimea Water Services is in the process of completing the Hydrology/Groundwater Impact Analysis. This scope of work involves understanding the dynamics of groundwater chemistry and hydraulics in the vicinity of the proposed Honokohau Harbor Expansion to accurately predict the impact of these flows to the new harbor and the impact of the harbor on fresh (brackish) water resources beneath adjoining properties, impacts of wastewater reuse, and storm runoff impacts to the site. This information will be used to formulate an updated description of the geology and groundwater hydrology in the project area. WWS is working with **AECOS Laboratory of Hawai'i, LLC** to obtain water quality measurements within the wells to assist in the prediction of fresh water and dissolved nutrient flows in the groundwater. This information is being compiled into a report along with recommendations for mitigation of any impacts identified during the study. To accomplish this goal Waimea Water Services (WWS) is currently working to:

- Recommend specific locations for the collection of water samples and the analyses to which these samples should be tested.
- Establish water level recordings in wells.
- Integrate geological information from existing studies with new information obtained from new borings on site.
- Use information from historical sources and bore logs from new holes to develop a description of the underlying geology of the site.
- Coordinate water sampling and analyses of water quality by AECOS Laboratory of Hawai'i, LLC at various wells and well depths to better understand the quantity and quality of groundwater.
- Review information from the above analyses and all other available historical observations and including recent observations by other researchers on adjacent parcels will be integrated into a cohesive description of groundwater dynamics of the project site. This understanding will be used to develop a description of potential impacts to and from marina development, wastewater injection and reuse, and storm runoff.
- Prepare recommendations for mitigation. A final report will be prepared suitable for public release that describes and integrates all of the activities and information obtained in this study.

Oceanic Institute in conjunction with **AECOS Laboratory of Hawai'i, LLC** is completing water quality testing and a Marine Biological Baseline Monitoring and Mitigation Plan. The work is being conducted to determine the current conditions of water quality and aquatic resources and habitats within and adjacent to Honokohau Harbor, the proposed Kona Kai Ola site, and at sites potentially impacted by the proposed development including increased runoff and drainage. Potentially-affected aquatic resources and habitats including benthic and fish communities associated with nearshore coral reefs, recreational and commercial fisheries, anchialine ponds and associated organisms, are being analyzed. Current research is being conducted to see investigate any studies of generic impacts to coastal water quality and nearshore marine ecology

The study includes review of historical data for the affected areas, field data collection, data analysis, reporting, discussion and evaluation of potential impacts associated with proposed development activities, changes in runoff, sedimentation and possible increases in pollution. Biota monitoring is being performed in each of the eighteen (18) ponds located within or immediately adjacent the project site, six to the north of the Honokohau Harbor entrance channel, and 12 to the south.

The frequency, location and scope of the proposed baseline surveys, water pollutant testing and analyses have been designed to incorporate the current requirements of local and federal permitting agencies, and recognize the sensitive nature of adjacent areas, including the Kaloko-Honokohau Natural Historical Park and numerous popular dive and shoreline fishing sites.

It is known and documented that freshwater intrusion into the current marina and near shore areas causes many parameters to be out of compliance with the State Standards for water quality. (Hawai'i Administrative Rules, Title 11, Department of Health, Chapter 54). Therefore, **AECOS Laboratory of Hawai'i, LLC,** will be completing water quality testing. According to

the HAR, Title 11, Department of Health, Chapter 54-06, the West Side of Hawai'i has unique conditions for baseline studies. While HAR Chapter 54 sets forth the fundamental concepts and standards for marine water quality, the water quality consultant, AECOS Laboratory of Hawai'i, LLC, is ensuring that the Kona Kai Ola project also is consistent with the additional criteria of the West Hawai'i Coastal Monitoring Program. The accumulated data is then to be reviewed with other project data along the West Hawai'i coastline. Existing documents related to West Hawai'i water quality will be referenced, including any University of Hawai'i studies.

Water quality testing efforts were coordinated with Waimea Water Services and Oceanic Institute to select proper sites for groundwater/springs. Water samples are being collected from all significant anchialine ponds located within the project boundaries, on either side of the harbor entrance channel. All pollutants will not be measured. Instead, testing will be limited to ones that are reasonable to be suspected on or near the site. Testing parameters have been discussed with the National Park Service. The following parameters will be tested:

Water Quality Parameters - Near Shore Waters	
Chlorophyll *a*	µg / liter
Turbidity	NTU
Hydrogen ion concentration (pH)	units
Fecal Coliform	colony forming units (CFU) / 100 ml
Enterococci	colony forming units (CFU) / 100 ml
Nitrite plus Nitrate Nitrogen	µg N / liter
Ammonia Nitrogen	µg N / liter
Total Dissolved Nitrogen	µg N / liter
Phosphate	µg P / liter
Total Dissolved Phosphorus	µg P / liter
Salinity	parts per thousand (ppt)
Temperature	Degrees C.
Dissolved Oxygen	mg / liter
Silicate	µg Si / liter
Dissolved organic phosphorus	µg P / liter
Dissolved organic nitrogen	µg N / liter
Sea and weather conditions	to be noted

From: West Hawai'i Coastal Monitoring Program, Monitoring Protocol Guidelines, page 10, May 1992

Moffatt & Nichol, the engineering firm tasked with the marina design, is using the *DELFT3D* numerical model to analyze the impact of groundwater flows to the harbor and the impact on harbor currents and flushing rates. In order to determine impacts from the proposed Kona Kai Ola development, it is essential to accurately model these density currents and the stratification that occurs when fresh water enters the marina. Hydrodynamic models simulations will be used to assess both existing conditions and future marina development impacts on existing conditions. Information from the above studies on existing groundwater and harbor water quality will be used to complete simulations of impacts with and without various project conditions. All methodologies, results and conclusion will be assembled into a report for inclusion into the Draft EIS.

Oceanit is conducting a Zone of Mixing study using existing information, current measurements, water quality stratification measurements, and model results from the Moffatt & Nichol study. This study involves:

- ✓ Installing recording instruments to monitor salinity, temperature, pH, turbidity and dissolved oxygen concentration.
- ✓ Obtaining current data presently being conducted by USGS for the offshore area.
- ✓ Conducting water quality profiles along the shoreline during flood and ebb tides.
- ✓ Conducting water quality measurements in the harbor outflow plume.
- ✓ Using results from the Moffatt & Nichol study to project the predicted zone of mixing out into the nearshore waters.

Oceanit is preparing a report which estimates mixing levels and water quality variations in the nearshore area adjacent to the harbor entrance to determine the effective zone of mixing (ZOM), variations, dispersion and future water exchange. The report will evaluate impacts on surface water uses in the adjacent areas and navigational safety impacts. This information will then feed back into the analyses conducted by Oceanic Institute to predict impacts to nearshore marine communities.

3. *Anchialine Ponds, Threatened, Endangered or Protected Species (Terrestrial and Marine) and Invasive Marine Species*

Oceanic Institute is completing a Marine Community Biological Survey to address the impacts to the marine ecosystem. A marine biological survey has been conducted to establish baseline conditions. Primary biological communities included in the surveys are:

- ➢ Biological communities in two clusters of natural anchialine ponds located north and south of the Honokohau Harbor entrance channel;
- ➢ Benthic communities along transects located at each of nine (9) offshore survey sites;
- ➢ Fish communities occurring within the nine (9) offshore survey sites;
- ➢ Benthic communities within Honokohau Harbor;
- ➢ Fish communities within Honokohau Harbor.

Species diversity is being calculated for coral and algal communities using the Shannon-Weaver Index formula. Turtle and whale populations in the area are said to have been increasing over the past two decades, however any existing impact to these populations would most likely increase three-fold with expansion of the harbor. A final report will include recommendations to address any impacts to the marine community. This report will be submitted along with terrestrial flora (**Robert W. Hobdy**) and fauna (**Rana Productions Ltd.**) reports.

The impact of the project on threatened or endangered species will be covered on a species by species basis, in the Draft EIS. Preliminary research indicates that there are no known terrestrial threatened or endangered species on the site. Species of primary interest that will be discussed individually in the Draft EIS include:

Humpback Whales;
Green and Hawksbill Sea Turtles;
Hawaiian Monk Seals;
Hawaiian Coot;
Hawaiian Stilt.

Impacts to other important marine species including sea birds, dolphins, and billfish will also be discussed in the Draft EIS. Impacts to the anchialine pond shrimp species will also be discussed. The potential for increased importation of alien invasive marine species on boat hulls will also be discussed.

4. *Proposed Harbor Marina Design as it Impacts Water Quality and Safety*

Moffatt & Nichol, the engineering firm tasked with the marina design, is producing various models to analyze the impacts from the excavated marina. Previous studies and field measurements have demonstrated that the existing marina has a total volume exchange more than five times shorter than can be accounted for by tidal exchange alone. This rapid exchange rate is due to the very large (~8 mgd) groundwater flows entering the harbor. In order to determine impacts from the proposed Kona Kai Ola development, it is essential to accurately model these density currents and the various states of stratification that occur when fresh water enters the marina. Three hydrodynamic models simulations are being used to assess both existing conditions and future marina development impacts on existing conditions. Water quality simulations will be completed to determine impacts with and without various project conditions. All methodologies, results and conclusions will be assembled into a report for inclusion into the Draft EIS.

A marina boat traffic study is being completed by **Moffatt & Nichol.** It is important both from a marina planning point of view and as an important element of the Draft EIS for the overall project. The proposed project will add marina slips that will access the ocean via the existing marina entrance channel. The focus of this study is to address impacts of the proposed project to existing navigation. Tasks include a review of available reports and data relevant to the existing marina including slip mix and usage. Details of the marina layout including entrance dimensions for navigation, will be obtained. Moffatt & Nichol is collecting observations of the existing marina during peak weekend usage, and general marina function and traffic patterns. They are also conducting interviews with stakeholders and the harbor master. Boat counts have also been made in the entrance channel over two weekends and one weekday to help quantify boat usage patterns. The results of the preceding tasks are being applied to provide a quantitative assessment of the existing traffic levels within the marina entrance.

Standard marina entrance design guidelines for safe navigation are being reviewed to assess the entrance usage in terms of percent capacity, analogous to a level-of-service assessment for traffic analyses. Other marina sites are being investigated for comparison of size, slip count, entrance width and environmental conditions. Usage patterns measured for the existing marina are being applied to the proposed marina alternatives to quantify traffic levels. Boat traffic impacts to the existing marina are being assessed. Any required mitigation measures are being developed as appropriate. Finally, Moffat & Nichol will prepare a report summarizing the study findings and recommendations for inclusion in the Draft EIS.

5. *Buffer Zone of 400 Feet*

The developer and consultants have been in constant contact with DLNR's Office of Conservation and Coastal Lands, to discuss the preferred use (or non-use) of the proposed buffer zone as a passive shoreline cultural park. Since some of the area is zoned "Conservation", the uses are limited already. Various State agencies with oversight of the Conservation zone are looking at trail uses, passive public access features, shoreline fishing activities, and natural restoration within this setback. Use of this Conservation strip will be reviewed at the time of the CDUA and SMA permits and will be made conditions of approval at that time.

6. *LUC Conditions and Sustainable Development*

Consistent with its mission, Jacoby Development, Inc. (JDI) proposes to create a comprehensive development at Kona Kai Ola that incorporates the latest technology and approaches to sustainability, recycling, reuse and low environmental impact development. The developer intends to seek *Leadership in Energy and Environmental Design* (LEED) certification with this development. This certification applies to the architecture of the buildings, operation of facilities, reduction in energy consumption and culturally-appropriate materials locally-produced, where possible. JDI has organized ongoing sustainable development charrettes throughout the design process for Kona Kai Ola and will continue to do so, as the development comes to fruition.

To provide a sustainable energy source, JDI is considering using a seawater air conditioning (SWAC) system for the project site. SWAC provides a sustainable, renewable resource that could result in reduced energy costs for the project and a reduced impact on HELCo resources.

In SWAC:
- Sea water is pumped from a deep cold-water source in the ocean;
- The water is passed through a heat exchanger;
- A closed-loop fresh water distribution system is pumped through the heat exchanger cooling the water;
- The cooled fresh water loop is distributed to buildings for air conditioning;
- Effluent sea water will be naturally high in nutrients and will either be pumped off site for secondary use (aquaculture, bottled water, etc) or be disposed of in a deep injection well.

JDI is currently not required to comply with LEED or any other sustainable criteria, beyond the minimum development requirements of regulatory agencies. While requiring compliance with standard conditions, these various agencies may create additional conditions of approval as part of the individual review of their permits.

7. *Viewscape, Air Quality and Noise*

Visual impacts are a concern of the developer as well as the National Park Service. Preliminary design of the structures, density, location and landscaping demonstrate an attempt to keep a low profile with minimum adverse impacts to the viewscape. These impacts from the viewpoint of the National Park may be reviewed as part of the Draft EIS. Once the plan is formalized at the entitlement stage, these will be discussed and publicly reviewed as part of the SMA, Corp of Engineers and CDUA permits. All proposed development will be required to comply with any applicable National Park Service policies and requirements related to aesthetics and visual impacts on non-NPS properties. One known design point of potential contention is the placement of the DOBOR harbor control tower on the northern shore of the harbor at the junction of the two marina channels. This location makes the structure visible from the back entry to the National Park. We would like to discuss potential design solutions for this structure that address both the needs of the National Park and the safety requirement of DOBOR.

Air quality and noise assessments are being conducted as part of the Draft EIS by **Barry D. Neal and Associates** and **D.L. Adams and Associates, Ltd.** respectively. These studies are using input from the traffic analysis by **Parsons Brinkerhoff Quade and Douglas.** All of these studies will be incorporate mitigation recommendations and all will be included as attachments to the Draft EIS.

The impact of increased quantities of noise from small boat traffic on marine life will be addressed. As the National Park is presently monitoring underwater noise as part of an independent study, we appreciate your input on this new field of study. Again, thank you for your input. Your comment letter along with this response letter will be included as part of the Draft EIS.

Sincerely,

Jeff Merz, AICP
Senior Planner
Oceanit

Appendix B

Comment Letters and Responses to the Draft Environmental Impact Statement

FEDERAL

Land Division

Fax

To:	D. Scott Mackinnon	**From:**	Gavin Chun
Fax:	524-8293	**Pages:**	5 (Including cover)
Phone:		**Date:**	6/4/2007
Re:	Kona Kai Ola Project	**CC:**	

☐ **Urgent** ☐ **For Review** ☐ **Please Comment** ☐ **Please Reply** ☐ **Please Recycle**

● **Comments:**

LINDA LINGLE
GOVERNOR OF HAWAII

ALLAN A. SMITH
INTERIM CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
DEPUTY DIRECTOR

PETER T. YOUNG
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

Ref. No.: 03HD-153

May 31, 2007

VIA FACSIMILE; ORIGINAL BY U.S. MAIL

Mr. James F. Jacoby
Mr. Scott Condra
Jacoby Development, Inc.
171 17th Street, NW, Suite 1550
Atlanta, Georgia 30363

Re: Kona Kai Ola Project

Dear Mssrs. Jacoby and Condra:

In a letter dated April 20, 2007, the Department of Land and Natural Resources ("DLNR") submitted to you objections to JDI's Master Development Plan, Master Covenants, Conditions and Restrictions, and Core Infrastructure Plan. These objections were presented in the form of memoranda from various DLNR divisions, including DLNR's Division of Boating and Ocean Recreation ("DOBOR").

As indicated in DOBOR's memorandum to former Chairperson Peter Young dated April 18, 2007, the entrance channel is considered a federally authorized navigation feature under the jurisdiction of the U.S. Army Corps of Engineers ("COE") and forthcoming comments from COE would be included as part of DOBOR's comments.

Accordingly, comments from the COE are attached for your consideration.

Very truly yours,

Allan A. Smith
Interim Chairperson

Enclosure

cc: Mr. Chad A. Martin (Fax: 407-876-7915)
Robert Klein, Esa. (Fax: 808-524-8293)
D. Scott MacKinnon, Esq. (Fax: 808-524-8293)
Land Board Members
Central Files
District Files

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, HONOLULU
FORT SHAFTER, HAWAII 96858-5440

REPLY TO
ATTENTION OF:

May 7, 2007

Civil Works Technical Branch
Engineering and Construction Division

MAY 9 '07 PM 9:42 30R ...

Mr. Edward Underwood, Administrator
State of Hawaii
Department of Land and Natural Resources
Division of Boating and Ocean Recreation
333 Queen Street., Suite 300
Honolulu, Hawaii 96813

Dear Mr. Underwood:

Per your request, we have reviewed the Draft Environmental Impact Statement for the proposed Kona Kai Ola Marina in Kealakehe, Kona, Island of Hawaii and provide the following comments:

- The Marina Boat Traffic Study concludes that under the current proposed plan utilizing and sharing the existing Honokohau Harbor entrance channel "Adding 800 slips in the new marina may cause entrance channel congestion during varying combinations of existing and new marina peak traffic flow.", including capacity exceedance and possible severe congestion during peak usage periods. The report suggests mitigation measures such as boater education, improved signage for boaters, the implementation of a manned traffic control tower or harbor control, etc. These measures only address safety issues within the entrance channel, but do not address the potential increased boat traffic within the channel.

- The guideline for entrance channel width based on boat traffic congestion noted on p.25 of Appendix P, notes that this guideline would suggest an entrance channel width in excess of 300 feet, but is based on high usage by tacking sailboats, and therefore, may not be directly applicable to Honokohau Harbor. Additional general guidance is available that states channel width may be based on five times the design vessel beam plus 10% of the number of boats using the harbor. Using the 25' beam width stated in the report and the increased number of slips would result in (5 x 25' beam + 10% of 1,072 slips) = 232 foot entrance channel width, not accounting for additional launched boat traffic. In addition, both of these guidelines are intended for use in straight channels. The sharp turn within the Honokohau Harbor entrance channel would require additional maneuvering space and channel width, which we suggest the consultant determine in their documentation. (Coastal Engineering Manual, V-5-6). In summary, available design guidance for channel based on boat traffic congestion indicates that the existing channel would not be of sufficient width, if the proposed plan of adding 800 additional slips were completed.

• The study does not address the impacts of increased boat traffic or expected level of service within the entrance channel, to account for the effects of the sharp turn in the entrance channel. It also does not address whether the proposed project will result in an increase in design vessel length, which may reduce maneuverability around the turn in the channel and result in the need for increased channel width at the turn.

• The Marina Boat Traffic Study concludes that widening the entrance channel by approximately 50 feet could reduce projected traffic congestion in half. The criterion for this assertion is not shown or explained.

• The Marina Boat Traffic Study also notes that widening of the channel could increase wave penetration into the harbor, and this is noted as a possible down side to channel widening. However, this possibility is not addressed nor quantified in the Wave Penetration Study in Appendix I, and should not be considered an argument against channel widening until analyzed.

• Due to the significant impacts that the proposed plan will have on entrance channel congestion and safety, further discussion should be included in the report to address the feasibility and procedures required for widening the channel, and the effects this would have on improving congestion, reducing safety hazards, increased wave penetration into the harbor, and potential future growth of the harbor. This would enable a more thorough analysis of the advantages and disadvantages of channel widening. Some discussion should also be presented on the possibilities of creating an additional channel, even if only to note whether or not it is cost prohibitive.

• If the State or the consultant are considering any widening, deepening, or navigational changes at the entrance or within the current Federal channel limits, such work is not currently Federally authorized. Planning and engineering investigations must be either performed by USACE under our current authorities or, if approved, by non-Federal interests, under Section 204 of the Water Resources Development Act of 1986. If your agency or designated agent is contemplating such changes, we are available to discuss the required documents and approvals. Keep in mind that improvements are not eligible to be maintained by the Federal government unless the Federal government later assumes operations and maintenance responsibilities in accordance with approvals granted *prior* to the non-Federal construction. In addition, non-Federal work will also require USACE Regulatory permits further discussed below.

• Regulatory Program comments: The proposed development will require the submittal of an Individual Department of Army (DA) permit application and environmental documentation which will allow the Corps to evaluate the probable impact, including cumulative impacts, of the proposed Kona Kai Ola Marina on the public interest. The decision to authorize or deny the DA application will reflect the national concern for both protection and utilization of important resources. The benefit which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal will be considered including the cumulative effects thereof; among those are conservation, economics, aesthetics, general environmental concerns, wetlands, anchialine ponds, local and national historic properties, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership and, in general, the needs and welfare of the people.

Should you have any questions regarding this matter or the comments provided, please do not hesitate to contact Ms. Jessica Hays of my Civil Works Technical Branch at 438-1680.

Sincerely,

Todd C. Barnes

Todd C. Barnes, P.E.
Chief, Engineering and
Construction Division

oceanit
innovation through engineering & scientific excellence

July 23, 2007

Allan Smith, Interim Director
State of Hawai'i Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawai'i 96809

Dear Mr. Smith:

Subject: Kona Kai Ola Draft Environmental Impact Statement
Response to Your Comments Dated May 31, 2007

Your letter dated May 31, 2007, to Jacoby Development, Inc., included an attached letter dated May 7, 2007, from Todd Barnes, Chief of the Engineering and Construction Division of the U.S. Army Engineer District, Honolulu, Department of the Army. We acknowledge your comment that the entrance channel is considered a federally authorized navigation feature under the jurisdiction of the U.S. Army Corps of Engineers (COE). We also note that forthcoming comments from the COE would be included as part of DOBOR's comments.

While your letter and attachment do not specifically address the DEIS or EIS process, we are including both letters in the EIS as comment letters because relevance to the EIS.

Your comment letter and this response are included in the Final Environmental Impact Statement. We appreciate your participation in the environmental review process.

Sincerely,

Dayan Vithanage, P.E., PhD.
Director of Engineering

cc: Office of Environmental Quality Control
State Department of Hawaiian Home Lands
Jacoby Development, Inc.

July 23, 2007

Mr. Todd C. Barnes
Chief, Engineering and Construction Branch
U.S. Army Engineer District, Honolulu
Fort Shafter, Hawaiʻi 96858-5440

Dear Mr. Barnes:

Subject: Kona Kai Ola Draft Environmental Impact Statement
Response to Your Comments Dated May 7, 2007

We are in receipt of your letter dated May 7, 2007, to Mr. Edward Underwood, Administrator of the Division of Boating and Ocean Recreation, State Department of Land and Natural Resources regarding the Kona Kai Ola Draft Environmental Impact Statement (DEIS). You had reviewed the DEIS at the request of Mr. Underwood. Although your letter was received after the required DEIS 45-day comment period which ended February 6, 2007, we are including your letter and this response in the Final EIS.

Before we respond to your specific comments, we are hereby providing information regarding an update of additional alternatives analysis which was conducted subsequent to the publication of the DEIS. This information is integral to our responses to your comments.

As explained in the DEIS, the agreement between JDI and the State of Hawaiʻi established a required scope and scale of the project for which the impact analysis was provided. Several comments have addressed the fact that alternatives other than the No Project Alternative were not addressed in the DEIS Section 2, Alternatives Analysis.

Kona Kai Ola is of the position that alternative actions other than a No Project alternative are not currently feasible without an amendment to the agreement with the State. Agency and public comments in response to the DEIS, as well as additional information generated as a result of inquiry into issues raised by the comments, have been helpful in identifying alternative actions that will serve the State's goal of providing additional marina slips for the Kona area. These alternative actions also serve to reduce or mitigate anticipated effects of the proposed development.

Thus, agencies such as the Land Division of the Department of Land and Natural Resources, the U.S. Department of the Interior Fish and Wildlife Service, and the Planning Department of the County of Hawaiʻi, and the Office of Environmental Quality Control (OEQC), as well as community organizations, have commented that a reduced scale marina and related facilities should be considered.

The OEQC has also asked that the alternative of a reduced scale project be evaluated under the assumption that DHHL may determine that a downsized project would be preferred.

In response to these comments on the DEIS and in consideration of measures to mitigate anticipated impacts, the EIS Section 2, Alternatives Analysis, has been revised to describe the following alternatives, which are discussed in more detail in the EIS:

- Alternative 1 is a project involving a 400-slip marina, 400 hotel units, 1,100 time-share units, and commercial and support facilities. This alternative would enhance water quality and avoid the need to widen the existing harbor entrance channel, as well as reduce traffic and socioeconomic impacts.
- Alternative 2 is an alternative that had been previously discussed, but not included in the proposed project that includes an 800-slip harbor and a golf course.
- Alternative 3 is the no-action alternative.

A comparison between impacts related to the proposed project concept and impacts related to Alternative 1 indicates that a reduction in the acreage and number of slips in the marina, as well as the reduction in hotel and timeshare units, would generate less environmental, traffic, social and economic impacts. Although positive economic impacts would be reduced, Alternative 1 can be considered as a preferable alternative because of reduced environmental impacts. However, while it can be concluded that the 25-acre marina in Alternative 1 would be the preferred size, the DLNR agreement establishes the size of the marina at 45 acres and 800 slips. An amendment to the DLNR agreement is required in order to allow Alternative 1 to proceed. Hence, selection of Alternative 1 is an unresolved issue at this time.

The revised text of Section 2, Alternatives Analysis, is attached to this letter as Attachment 1.

Responses are provided to specific comments as identified by page and "bullet" number.

Page 1, Bullet 1 – *The Marina Boat Traffic Study concludes that under the current proposed plan utilizing and sharing the existing Honokohau Harbor entrance channel "Adding 800 slips in the new marina may cause entrance channel congestion during varying combinations of existing and new marina peak traffic flow," including capacity exceedence and possible severe congestion during peak usage periods. The report suggests mitigation measures such as boater education, improved signage for boaters, the implementation of a manned traffic control tower or harbor control, etc. These measures only address safety issues within the entrance channel, but do not address the increased boat traffic within the channel.*

Response – Moffatt and Nichol prepared the Marina Boat Traffic Study, which is included as Appendix Q-1 of the EIS. In Section 7 of this study, there are a total of seven suggested measures to reduce or eliminate the impacts of channel traffic congestion, not including channel widening. In addition to those mentioned in the comment, which are more safety oriented, the study also suggested the following which focus more on mitigation of traffic congestion:

- Since the peak traffic occurs during relatively short periods of time (i.e. one hour), some form of traffic control including staggering of sportfish tournament traffic or some other form of traffic control could be implemented in the event that excessive traffic congestion becomes an issue. For example, boaters must request permission to enter/exit harbor at Ko Olina as a control measure to coordinate with existing commercial ship traffic in the entrance. A possible scenario at the proposed marina may include stationing harbor patrol at the entrance during peak morning and afternoon hours to assist in traffic control and expedite orderly and expeditious entry and/or exit of the channel.

- Canoe paddlers could be officially restricted to the shallower edges of the channel during peak hours if a safety threat or other traffic congestion issue arises.

Subsequent to the DEIS, Moffatt and Nichol investigated a further-reduced marina to a 25-acre basin with 400-slips, as contained in Alternative 1. The reduced basin size was investigated to reduce water quality impacts to acceptable levels. The Water Quality Modeling Report is contained in Appendix U.

Under average existing conditions with the 400-slip marina, a maximum of 50 percent of the channel capacity is used (LOS D). During peak existing conditions, 90 percent of the capacity is used (LOS E). Traffic reductions relative to the 800-slip marina are 21 percent for average conditions and 10 percent for peak conditions.

Page 1, Bullet 2a – *The guideline for entrance channel width based on boat traffic congestions noted on p.25 of Appendix P, notes that this guideline would suggest an entrance channel width in excess of 300 feet, but is based on high usage by tacking sailboats, and therefore, may not be directly applicable to Honokohau Harbor. Additional general guidance is available that states channel width may be based on five times the design vessel beam plus 10% of the number of boats using the harbor. Using the 25' beam width stated in the report and increased number of slips would result in (5x25'beam = 10% of 1,072 slips) = 232 foot entrance channel width, not accounting for additional launched boat traffic.*

Response – The referenced guidance from the Coastal Engineering Manual (CEM) of sizing a marina channel (5 times the design vessel beam plus 10% of the number of boats using the harbor) is for sizing interior or intermediate channels only, not for ocean entrance channels. This is made clear in the original reference[1].

More importantly, however, the boat traffic study points out that entrance channel width and overall navigability criteria are highly variable with little consensus on required entrance channel width as a function of marina size. For that reason, the boat traffic study investigated other small craft harbors with comparable entrance widths and boat counts. These other examples also do not meet published guidelines, but have a long history of safe navigation.

Moffatt and Nichol interviewed harbor administrators and long time users of Honokohau Harbor to further understand the level of congestion of the existing harbor and anticipated impacts of future expansion. The interview findings were very valuable in developing the list of recommended mitigation measures to accommodate the additional channel usage.

Page 1, Bullet 2b – *In addition, both of these guidelines are intended for use in straight channels. The sharp turn within the Honokohau Harbor entrance channel would require additional maneuvering space and channel width, which we suggest the consultant determine in their documentation (Coastal Engineering Manual,V-5-6). In summary, available design guidance for channel based on boat traffic congestion indicates that the existing channel would not be of sufficient width, if the proposed plan of adding 800 slips were completed.*

Response – It should first be pointed out that the harbor entrance channel includes the sharp turn for the purpose of reducing wave penetration into the berthing basins[2].

We strongly agree that safe navigation at the turn in the channel is critical. It had been cited in interviews with harbor users, specifically navigating the turn in big waves and the "blind spot." The entrance channel turn is an issue for the existing harbor users, and will be for the new marina users. Increased harbor patrol, better vantage and view for the harbor patrol, and increased education on how to navigate the entrance during high wave conditions are strongly recommended to offset the impact of the additional users of the entrance channel.

In addition, reconfiguration of the fuel dock will eliminate the present practice of stern-to mooring in the outer basin which will provide some limited additional maneuvering space in the vicinity of the turn. Reorientation of the transient slips to alongside berthing would also provide useful additional maneuvering space.

Page 2, Bullet 3 – *The study does not address the impacts of the increased boat traffic or expected level of service within the entrance channel, to account for the*

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[1] *Nichol, J.M. 1985. "Observations in Small Boat Harbors – Harbor Design Concepts," Proceedings West Coastal Regional Coastal Design Conference. American Society of Civil Engineers. Oakland, CA.*

[2] *US Army Engineer District, Honolulu, 1968.* General Design Memorandum – Honokohau Harbor for Light Draft Vessels.

effects of the sharp turn in the entrance channel. It also does not address whether the proposed project will result in an increase in design vessel length, which may reduce maneuverability around the turn in the channel and result in the need for increased channel width at the turn.

Response – Plans include a limited number of vessels in the 80-120 foot range, thereby increasing the size of the harbor design vessel. As stated in the boat traffic study, operators of this size vessel are typically highly skilled and will exercise proper care when navigating the turn. The 120-foot design vessel was considered the maximum size for the new harbor based on entrance channel dimensions. The existing channel configuration is considered sufficient for navigation of this design vessel exercising appropriate judgment and seamanship.

Page 2, Bullet 4 – *The Marina Boat Traffic Study concludes that widening the entrance channel by 50 feet could reduce projected traffic congestion in half. The criterion for this assertion is not shown or explained.*

Response – As stated in Section 7.0 of the Boat Traffic Study, Item 1, widening the channel by 50 feet would effectively add another equivalent "lane" of traffic, thereby allowing a full passing lane that could be used as a second lane for peak traffic congestion. This would double the capacity since the peak traffic flow would have two lanes of travel instead on one. For example, in the peak morning hours for outbound traffic, there could be two lanes for outbound and one lane inbound, rather than the present channel width that accommodates the equivalent of one lane of traffic in each direction.

Regarding Alternative 1, the following text has been added to Section 4.8.2:

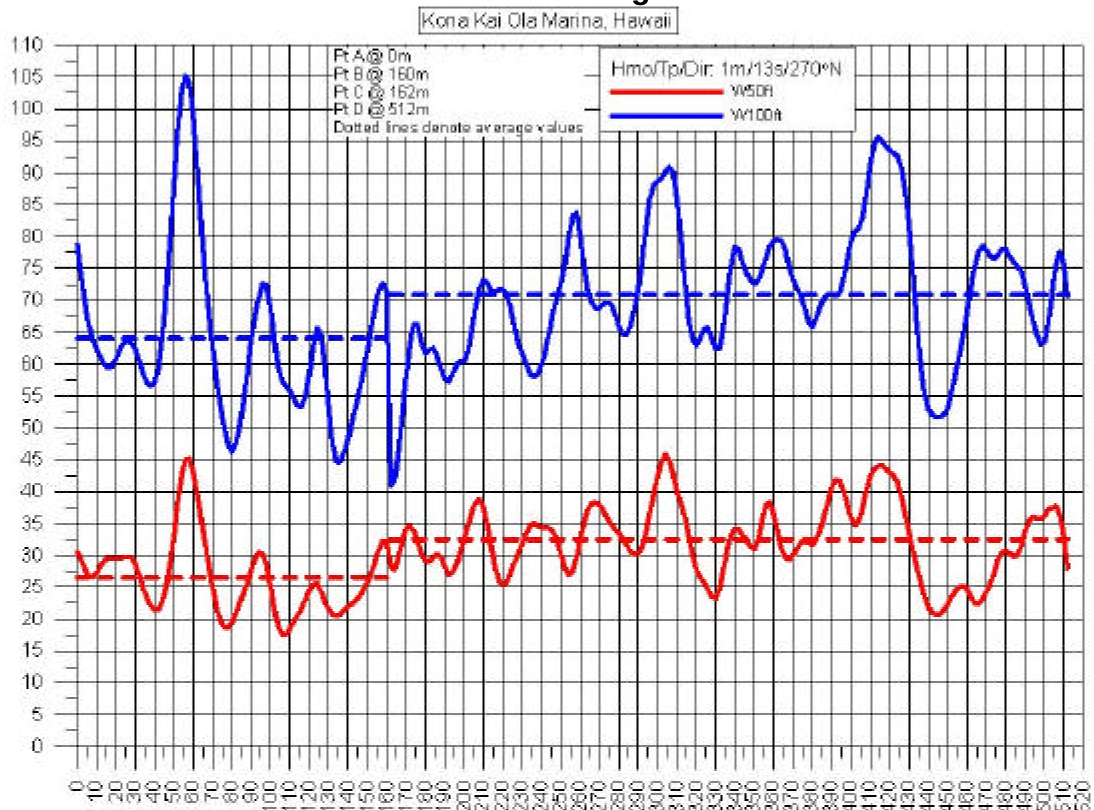
> <u>In response to DEIS comments, the sensitivity of boat traffic to size of marina expansion was analyzed for Alternative 1, which features a 400-slip marina. The reduction of the marina from 800 to 400 slips results in a 21 percent reduction in boat traffic congestion under average existing conditions and ten percent during peak existing conditions. The LOS improves from E to D during average existing traffic condition, although remains at E during peak conditions.</u>
>
> <u>This reduction to 400 slips reduces the problems of congestion at the entrance channel, thereby reducing the need for any modifications to the entrance channel.</u>

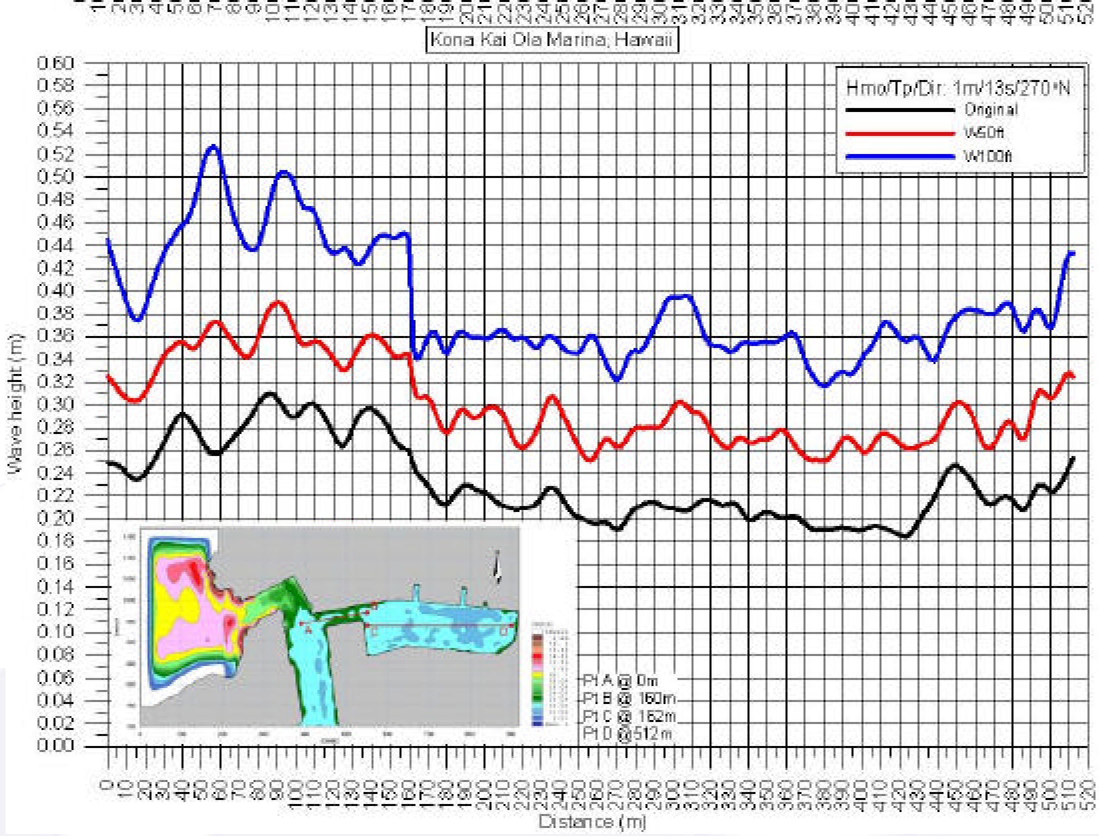
Page 2, Bullet 5 – *The Marina Boat Traffic Study also notes that widening of the entrance channel could increase wave penetration into the harbor, and this is noted as a possible down side to channel widening. However, this possibility is not addressed nor quantified in the wave penetration study in Appendix I, and should not be considered an argument against channel widening until analyzed.*

Response – In response to this comment, additional wave penetration model runs were performed to quantify any additional wave penetration into the existing harbor associated with widening of the entrance channel. Channel widening scenarios of 50 feet and 100 feet were analyzed. Channel widening was assumed to be done on the south side of the channel to avoid encroachment into

National Park Service property. The plots on the following page clearly demonstrate additional wave penetration into the existing harbor due to entrance channel widening. The 50 foot width addition allows an additional average wave height increase of 25% to 35%; the 100 foot width addition allows 65% to 75% increase in wave heights.

Wave Height Increase in Existing Harbor for 50’ and 100’ Entrance Widening





Page 2, Bullet 6 – *Due to the significant impacts that the proposed plan will have on entrance channel congestion and safety, further discussion should be included in the report to address the feasibility and procedures required for widening the channel, and the effects this would have on improving congestion, reducing safety hazards, increasing wave penetration into the harbor, and potential future growth of the harbor. This would enable a more thorough analysis of the advantages and disadvantages of channel widening. Some discussion should also be presented on the possibilities of creating an additional channel, even if only to note whether or not it is cost prohibitive.*

Response – To reiterate from the responses to preceding comments, there would be significant advantage to boat traffic congestion reduction associated with channel widening. However, channel widening does not appear feasible due to the significant increase in wave penetration into the existing harbor, as well as the complex process of authorization of federal channel modification. Construction of a separate entrance channel would pose even greater regulatory issues, and is not considered feasible in light of concerns of environmental impact.

As previously discussed, the reduction of the marina from 800 to 400 slips in Alternative 1 results in a 21 percent reduction in boat traffic congestion under average existing conditions and ten percent during peak existing conditions. This reduction to 400 slips reduces the problems of congestion at the entrance channel, thereby reducing the need for any modifications to the entrance channel.

Page 2, Bullet 7 – *If the State or consultant are consider any widening, deepening, or navigational changes at the entrance or within the current Federal channel limits, such work is not currently Federally authorized. Planning and engineering investigations must either be performed by USACE under our current authorities or, if approved, by non-Federal interests, under Section 204 of the Water Resources Development Act of 1986. If your agency or designated agent is contemplating such changes, we are available to discuss the required documents and approvals. Keep in mind that improvements are not eligible to be maintained by the Federal government unless the Federal government later assumes operations and maintenance responsibilities in accordance with approvals granted prior to the non-Federal construction. In addition, non-Federal work will also require USACE Regulatory permits further discussed below.*

Response – There are no plans to modify the entrance channel.

Page 2, Bullet 8 – *Regulatory Program comments: The proposed development will require the submittal of an Individual Department of Army (DA) permit application and environmental documentation which will allow the Corps to evaluate the probable impact, including cumulative impacts, of the proposed Kona Kai Ola Marina on the public interest. The decision to authorize or deny the DA application will reflect the national concern for both protection and utilization of important resources. The benefit which reasonably may be* *expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal will be considered including the cumulative effects thereof; among those are conservation, economics, aesthetics, general environmental concerns, wetlands, anchialine ponds, local and national historic properties, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership and, in general, the needs and welfare of the people.*

Response: We have expanded the EIS to include the Department of the Army Individual Permit, and the following table is included in Section 5.3, Permits Required for Project:

Table 3: Permits Required for the Project

Agency	Permit or Approval	Requirement	Time Frame
U.S. Army Corps of Engineers	Department of the Army (DOA) Individual Permit	Work in navigable waters; placing fill in waters of the U.S., placing navigation aids Will incorporate: ▪ Rivers and Harbors Act Section 10 ▪ Clean Water Act Sections 401 and 404 ▪ Coastal Zone Management Act Section 307 ▪ Endangered Species Act Section 7 ▪ National Historic Preservation Act Section 106	Prior to any in-water work or fill or placement of navigation aids or modification of terrestrial habitat that may impact species listed under Endangered Species Act
U.S. Coast Guard	Private Aids to Navigation approval	For approval for marking aids to navigation	Prior to placement. Note: placement requires DOA Permit.
State Board of Land and Natural Resources	Easement over Submerged Lands / Shared Harbor Channel Entrance	HRS Section 171-53 (6)	Prior to commencement of operations of new marina
State Department of Business, Economic Development & Tourism	Determination of Hotel Development	HRS Section 171-42	Prior to approval of Master Development Plan

Agency	Permit or Approval	Requirement	Time Frame
State Department of Land and Natural Resources (DLNR) Office of Conservation and Coastal Lands (OCCL)	Conservation District Use Permit (CDUP)	For any work in the conservation district ▪ Kuakini Highway extension and SWAC pipe; Shoreline Park ▪ Hawaiian Cultural Park, Ocean Front Trail	Prior to any work in the conservation district
DLNR Commission on Water Resource Management	Well Construction Permit, Pump Installation Permit	For well construction or ground water source development	Prior to construction or development
State Department of Health (DOH) Clean Water Branch	401 Water Quality Certification	Triggered by DOA permit	Start simultaneously with DOA permit
		NPDES	
	- Individual Permit	Discharge into state waters	Prior to construction
	- NOI Appendix C	Construction activities on one or more acres	Prior to construction
	- NOI Appendix G	Construction dewatering	Prior to construction
	- NOI Appendix L	Discharge of circulation water from decorative ponds	Prior to construction
	All NPDES applications	Copy to DLNR/State Historic Preservation Division	Simultaneously with DOH NPDES submittals
	Zone of Mixing	Include with NPDES for discharge into state waters	Concurrent with NPDES application
DOH Safe Drinking Water Branch	Water Source Approval and capacity demonstration	For new drinking water sources	After source is identified
	Operator Certification	For operators of water systems	Before system use
	Construction Plan Review	For water system improvements and connections	Before construction
	Underground Injection Control (UIC) Permit	For injection well operations	Before operations
DOH Clean Air Branch	Dust control management plan	Recommended only, not required	During construction planning
DOH Noise, Radiation, & Indoor Air Quality Branch	No permit	Comply with Administrative Rules Chapter 11-46, Community Noise Control	During construction

Agency	Permit or Approval	Requirement	Time Frame
County of Hawai‘i	Special Management Area (SMA) Major Permit	Work in the SMA	Prior to any construction or other work in the SMA (does not include DHHL land)
	Zoning	Must be consistent with the General Plan	After acceptance of EIS
	Building Permit	To erect a new structure including fences, swimming pools and retaining walls more than 3’-0" in height, and water catchments regardless of depth or capacity	Prior to construction
	Grading, Grubbing, and Stockpiling Permits	For volumes as specified by county	Prior to activity
	Development, subdivision, drainage and flood zone reviews	For development	Prior to construction

Your comment letter and this response are included in the Final Environmental Impact Statement. We appreciate your participation in the environmental review process. Please submit a request to our office if you would like to receive a printed or electronic copy of the Final Environmental Impact Statement, or portions thereof.

Sincerely,

Dayan Vithanage, P.E., PhD.
Director of Engineering

cc: Office of Environmental Quality Control
State Department of Hawaiian Home Lands
Jacoby Development, Inc.

Attachment 1

2 Alternatives Analysis

~~In typical land development projects, the initial planning process includes the exploration of alternatives to development objectives. In the EIS process, these alternatives are presented with a disclosure of reasons for the dismissal of non-preferred alternatives.~~

~~Kona Kai Ola does not follow this same pattern of alternatives evaluation.~~ As discussed in Section 1.4, the proposed Kona Kai Ola project is the result of agreements between JDI and the State DLNR and DHHL. The agreements and leases between the State and JDI stipulate the parameters of development for this site in terms of uses, quantities and size of many features, resulting in a limited range of land uses. Unlike a private property project, JDI is required to meet the criteria outlined in the agreements, thereby affording less flexibility in options and uses. From the developer's perspective, the agreements must also provide sufficient flexibility to allow for a development product that responds to market needs and provides a reasonable rate of return on the private investment.

The agreements between JDI and DLNR specify that the proposed harbor basin is to be 45 acres and accommodate 800 slips. This development proposal is the subject of this EIS. In response to DEIS comments, additional water quality studies and modeling were conducted. These studies determined that the water circulation in a 45-acre 800-slip marina would be insufficient to maintain the required standard of water quality. The models of water circulation suggest that a new 25-acre harbor basin could successfully maintain required water quality in the new harbor. Comments on the DEIS from DLNR, from other government agencies, the neighbors and the general community also called for the consideration of alternatives in the EIS, including a project with a smaller harbor basin and less density of hotel and time-share units.

In response to these comments on the DEIS, three alternatives are evaluated in this Final EIS and include Alternative 1, which is a plan with a 25-acre 400-slip harbor basin including a decrease in hotel and time-share units; Alternative 2, which is an alternative that had been previously discussed but not included in the proposed project, that includes an 800-slip harbor and a golf course; and Alternative 3, the no-project alternative. Each alternative is included in the EIS with an evaluation of their potential impacts. These project alternatives are presented to compare the levels of impacts and mitigation measures of the proposed project and alternative development schemes pursuant to requirements set forth in Chapter 343, HRS.

~~JDI is required to provide a new marina basin not less than 45 acres and a minimum of 800 new boat slips. Further, the agreements provide the following options for land uses at the project site:~~

- ~~Golf Course~~
- ~~Retail Commercial Facilities~~
- ~~Hotel Development Parcels~~
- ~~Marina Development Parcels~~
- ~~Community Benefit Development Parcels~~

~~JDI is not pursuing the golf course option and is proposing instead to create various water features throughout the project site. All other optional uses have been incorporated in Kona Kai Ola.~~

2.1 Project Alternatives

2.1.1 Alternative 1: 400-Slip Marina

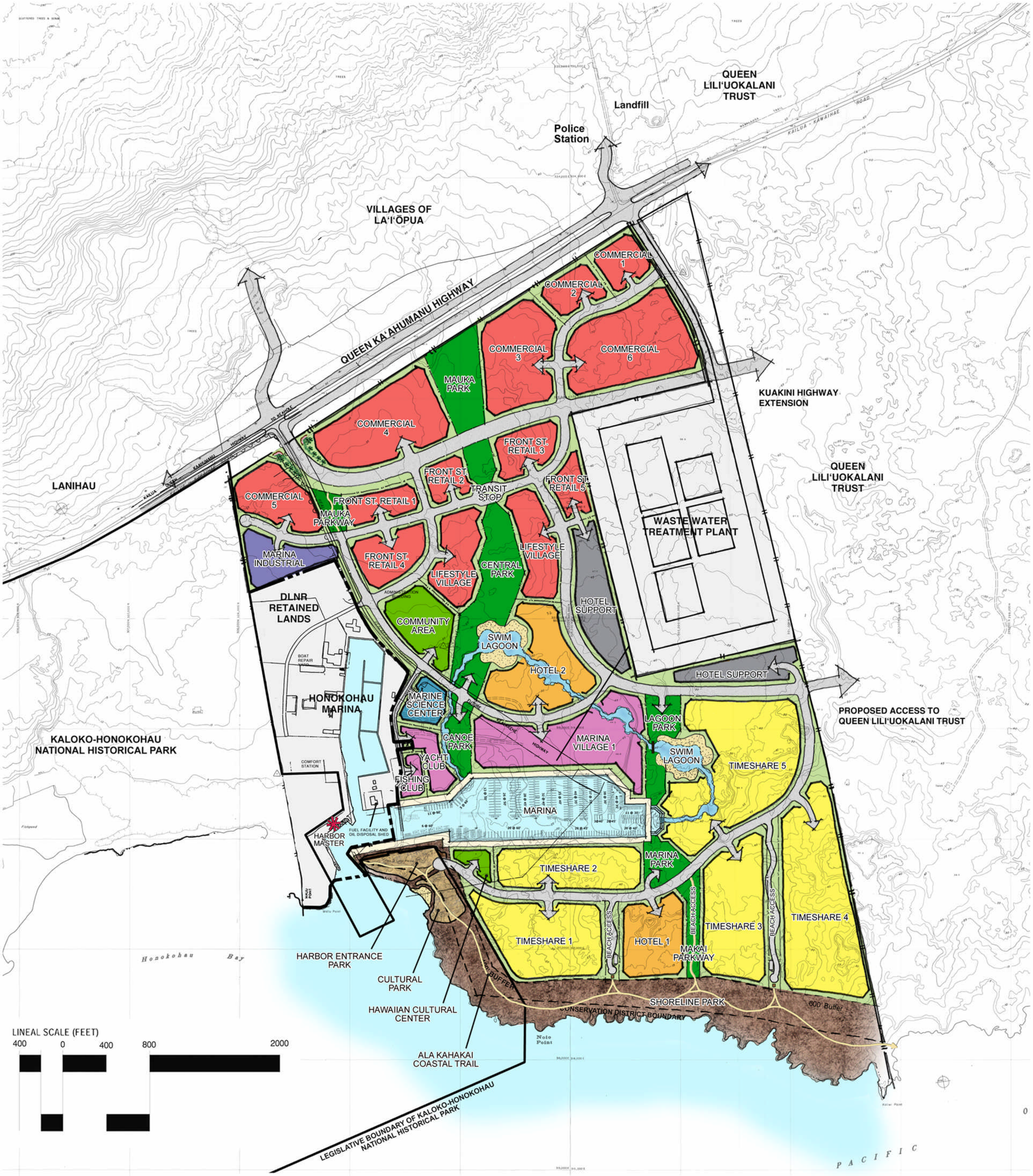
Studies conducted in response to DEIS comments found the construction and operation of an 800-slip marina may significantly impact the water quality within the marina and along the shoreline. Specifically, the Harbor Water Quality Modeling Study, as contained in Appendix U, found that the water circulation in a 45-acre 800-slip harbor was insufficient to maintain an acceptable level of water quality. Further, the existing harbor channel, which would serve both the existing and new harbors, could not adequately serve the increased boat traffic generated by an 800-slip marina during peak traffic. Mitigation measures to accommodate peak boat traffic included the widening of the existing channel, an action that would entail a complex process of Federal and State approvals and encounter significant environmental concern.

Concerns related to the proposed density of hotel and time-share units were also expressed in comments to the DEIS from members of the public, neighbors to the project site, especially the Kaniohale Community Association, and government agencies. Common themes in DEIS comments were related to impacts regarding traffic, project requirements of potable water and infrastructure systems, including sewer, drainage, utility and solid waste systems, and socioeconomic impacts.

In response to the water quality study results, and to the DEIS comments, an alternative plan was developed with a smaller marina with less boat slips, and a related decrease in hotel and time share units. Illustrated in Figure G, Alternative 1 reflects this lesser density project, and features a 400-slip marina encompassing 25 acres. For the purposes of the Alternative 1 analysis, JDI assumed 1,100 time-share units and 400 hotel rooms. Project components include:

- 400 hotel units on 34 acres
- 1,100 time-share units on 106 acres
- 143 acres of commercial uses
- 11 acres of marina support facilities
- 214 acres of parks, roads, open spaces, swim lagoons and community use areas

In addition, Alternative 1 would include the construction of a new intersection of Kealakehe Parkway with Queen Ka‘ahumanu Highway, and the extension of Kealakehe Parkway to join Kuakini Highway to cross the lands of Queen Lili‘uokalani Trust, and connecting with Kuakini Highway in Kailua-Kona. This is a significant off-site infrastructure improvement and is included in the agreements between the State and JDI.



Source: PBR HAWAII

Plan is conceptual only and subject to change

Figure G: Alternative 1: 400-Slip Marina

LEGEND

- TIME SHARE
- HOTEL
- RETAIL / COMMERCIAL
- MARINA RETAIL
- MARINA SUPPORT / COMMERCIAL
- MARINE SCIENCE CENTER
- COMMUNITY AREA / CULTURAL CENTER
- SWIM LAGOON
- MARINA
- UTILITIES
- PARKS & GREEN SPACE
- SHORELINE
- HARBOR ENTRANCE PARK / CULTURAL PARK

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Like the proposed project, Alternative 1 would have a strong ocean orientation, and project components that support this theme would include various water features including seawater lagoons and a marine science center. The new Alternative 1 harbor would include a yacht club, fishing club, a canoe park, and a cultural park with a focus on Hawaiian maritime cultural heritage of the voyaging canoe. The coastal area would be protected with a shoreline park with trails and public access parking for walking and shoreline fishing, and a cultural park surrounding the heiau, the cultural sites and 'Alula for community use. Additional Alternative 1 community areas would include facilities and space for community use, including programs of the Kona Kai Ola Community Foundation, which supports community programs in health care, culture, education, and employment training for the local community, especially to native Hawaiians. Like the original proposed plan, Alternative 1 includes 40 percent of the land in parks, roads, open spaces, swim lagoons and community use areas.

2.1.2 Alternative 2: Golf Course Feature

Alternative 2 was among the alternatives discussed at a community charrette in September 2003. It includes a golf course, which is a permitted use in the DLNR agreement and DHHL lease. As Figure H illustrates, an 18-hole championship golf course would occupy 222 acres on the southern portion of the project site. As with the proposed project, Alternative 2 includes an 800-slip marina on a minimum of 45 acres.

To support the economic viability of the project, other Alternative 2 uses include:

- Golf course clubhouse on three acres
- 1,570 visitor units on 88 acres fronting the marina
- 118 acres of commercial uses
- 23 acres of community uses

Community uses in Alternative 2 include an amphitheater, a canoe facilities park, a community health center, a Hawaiian cultural center and fishing village, a marine science center and employment training center. The sea water lagoon features contained in the proposed project and Alternative 1 are not included in this alternative.

2.1.3 Alternative 3: No Action

In Alternative 3, the project site would be left vacant, and the proposed marina, hotel and time-share facilities, commercial and marina industrial complexes, and community-oriented uses would not be realized.

~~The economic viability and sustainability of the project is determined by the density and uses proposed. Because JDI is obligated to develop an 800-slip marina for the State, complete road improvements, and provide various public enhancement features at its own expense, the density proposed for the income generating features of the development must be sufficient to provide an acceptable level of economic return for JDI. The market study, which is discussed in Section 4.6, reviewed various development schemes and determined that the currently proposed density and mix is the optimum to meet the anticipated financing and development cost obligations for the public features associated with the development.~~

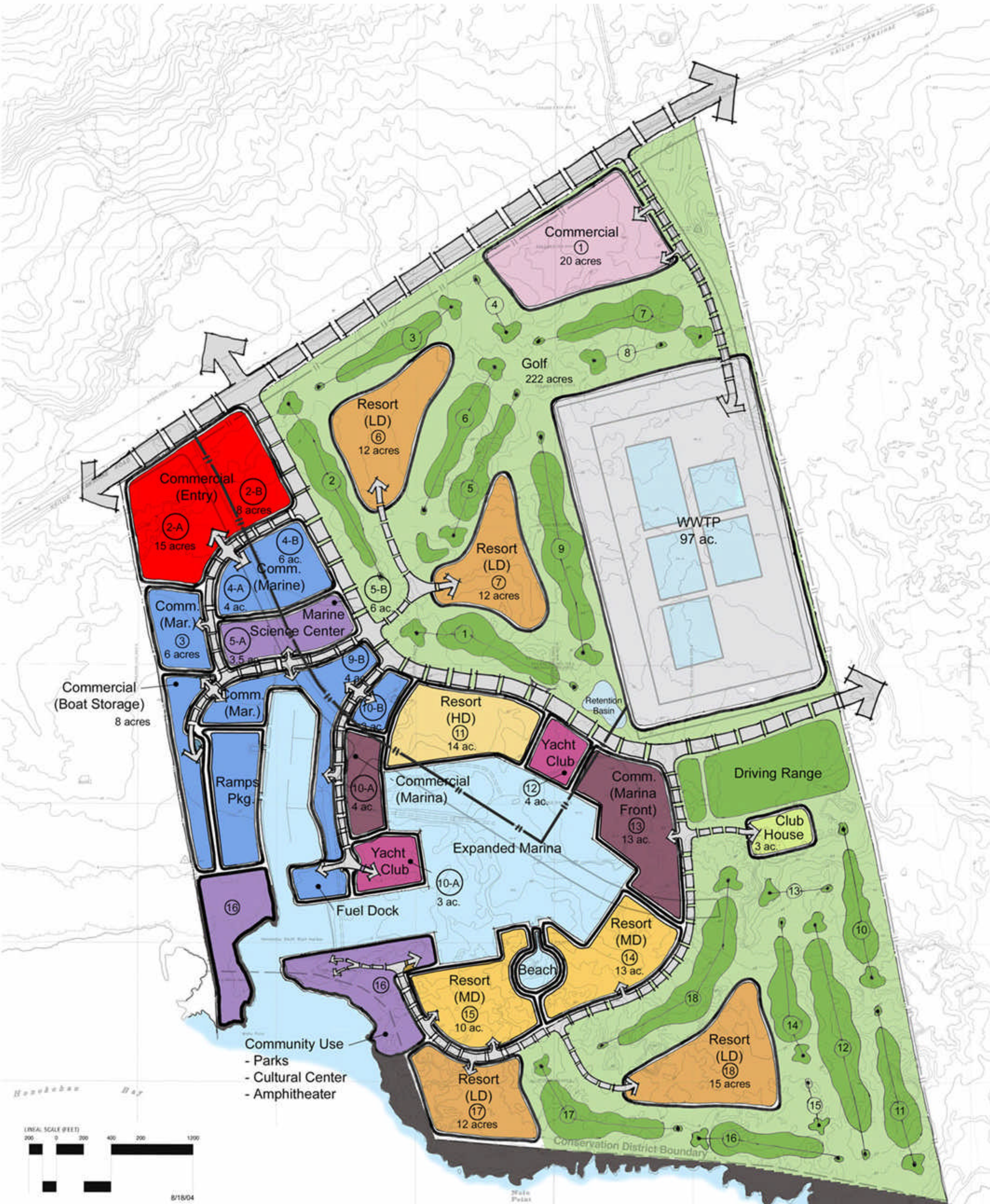

Figure H. Alternative 2: Golf Course Alternative

Legend

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2.2 Alternatives Analysis

As discussed in Section 2.1, the proposed Kona Kai Ola project (also referred to as “proposed project”) is defined by development requirements related for a marina and the related uses that would be needed to generate a reasonable rate of return that covers development costs.

Beginning with Section 2.2.1, the alternative development concepts are comparatively assessed for potential impacts that may reasonably be expected to result from each alternative. Following is an overview of the primary observations of such assessment.

Alternative 1 includes half of the State-required boat slips and 60 percent of the proposed hotel and time-share units and, due to the decreased density, this alternative would generate significantly less environmental and socio-economic impacts. A harbor water quality model found the reduction of the volume of the new marina basin by about half (approximately 25 acres) significantly improved the water circulation and quality. Further, the reduced number of boat slips would generate less boat traffic, thereby reducing congestion and the need to mitigate impacts further by the widening of the existing harbor channel.

A project with fewer hotel and time-share units and increased commercial space with a longer (14 years) absorption period would change the mix of employment offered by the project, and slightly increase the overall employment count. The public costs/benefits associated with Alternative 1 would change, compared to the proposed project, with a general increase in tax collections, and a general decrease in per capita costs. Detailed discussion of Alternative 1 potential economic impacts are provided in Section 4.6.6. Comparisons of levels of impact are presented throughout this FEIS.

While this analysis might indicate that the 25-acre marina in Alternative 1 would be the more prudent choice, the DLNR agreement establishes the minimum size and slip capacity of the marina at 45 acres and 800 slips, respectively. Amendments to the DLNR agreement would be required in order to allow Alternative 1 to proceed as the preferred alternative. Hence, selection of the preferred alternative is an unresolved issue at the writing of this FEIS.

Alternative 2, the golf course alternative, was not previously considered to be the preferred alternative primarily because market conditions at the time of project development might not likely support another golf course. Further, DHHL has a strategy goal to have more revenue-generating activities on the commercial lease lands within the project area. In addition, concerns have been expressed as to environmental impacts of coastal golf courses, including the potential adverse impact on Kona’s water supply if potable water is used for golf course irrigation.

While Alternative 3, the no-project alternative, would not generate adverse impacts related to development of these lands associated with the construction and long-term operations, it would also not allow for an expanded public marina that would meet public need and generate income for the public sector. Further, the no-project alternative would foreclose the opportunity to create a master-planned State-initiated development that would result in increased tax revenue, recreation options and community facilities. Crucial privately-funded improvements, such as the marina, regional roadway and circulation improvements, and improvements to the existing wastewater treatment plant, would not be implemented. Private funds toward the development of community-oriented facilities such as parks, other recreational facilities, and public access would not be contributed.

~~Hence, the only valid alternative to the proposed project is the no-action alternative. In this alternative, the project site would be left vacant, and the proposed marina, hotel and time-share facilities, commercial and marina industrial complexes, and community-oriented uses would not be realized.~~

~~The no-project alternative would therefore not generate adverse impacts associated with the construction and long-term operations would not occur.~~

~~Likewise, the creation of a master-planned state-initiated development, resulting in increased employment, tax revenue, recreation options and community facilities, would not be created. Privately-funded improvements, such as the marina, regional roadway and circulation improvements, and improvements to the existing wastewater treatment plant, would not be implemented. Private funds toward the development of community-oriented facilities such as parks, other recreational facilities and public access would not be contributed.~~

Further, the creation of revenue-producing businesses on the DHHL property to fund homestead programs would not occur, resulting in fewer potential benefits for Hawaiians.

Hence, the agreements and leases between the State and JDI indicate that the no-action alternative is not in the public interest~~has been rejected at this time~~.

2.2.1 Impact Comparison

Grading and Excavation

The proposed project requires grading and excavation. Both actions may impact groundwater due to rainfall runoff during construction. Alternative 1 would require a significantly smaller excavation for the marina basin and would therefore carry a lesser risk of potential adverse effects on water quality. Alternative 2 would require the same basin excavation as the proposed project, and would also include extensive grading and filling to build the golf course, the latter of which would generate additional impacts. Alternative 3 would result in no change to the geography, topography and geology.

Further discussion on grading and excavation is contained in Section 3.3.

Natural Drainage

Most precipitation infiltrates into the porous ground at the site, and no significant sheet flow is likely. Alternative 1 would generate similar levels of impacts on natural drainage as those of the proposed project and thus require similar mitigation measures. The golf course in Alternative 2 would not be as porous since the site would be graded, soil would be placed, and grass and other landscaping would be grown. Sheet flow and runoff can occur on a golf course, and drainage patterns might change. Alternative 3 would result in no change to the existing natural drainage pattern. Further discussion on natural drainage is contained in Section 3.4.

Air Quality

Air quality will be affected by construction activities, as well as pollutants from vehicular, industrial, natural, and agricultural sources. Alternative 1 would generate less construction air quality impacts than the proposed project due to the reduced amount of intensive groundwork associated with the smaller marina basin and fewer long-term impacts by reducing traffic 35 and 40 percent during, respectively, AM and PM peak traffic times. Construction of Alternative 2 would result in fugitive dust and exhaust from equipment and is expected to generate the same level of air quality impact as the proposed project. Alternative 3 would result in no change to existing air quality. Further discussion on air quality is contained in Section 3.5.

Terrestrial Environment

To provide additional habitat for shorebirds and some visiting seabirds, the project proposes to construct a brackishwater pond area suitable for avian fauna, including stilts, coots and ducks. While habitat expansion is beneficial, there is also a possibility that these species may be exposed to activity that may harm them. Alternative 1 would not include a brackish water pond, but will include 5 acres of seawater features, which is 74 percent less than the 19 acres of seawater features in the proposed project. While this would reduce beneficial impacts, it would also decrease exposure to potentially harmful activity. Alternative 2 does not include the brackish water pond features, but would include drainage retention basins that would attract avian fauna and expose them to chemicals used to maintain golf course landscaping. While Alternative 3 would result in no increase in potentially harmful activity, it would also not provide additional habitat for avian fauna. Further discussion on the terrestrial environment is contained in Section 3.7.

Groundwater

Groundwater at the project site occurs as a thin basal brackish water lens. It is influenced by tides and varies in flow direction and salt content. The existing Honokōhau Harbor acts as a drainage point for local groundwater. Any impact to groundwater flow from the proposed harbor is likely to be localized. The proposed marina basin will not result in any significant increase in groundwater flow to the coastline, but rather a concentration and redirection of the existing flows to the harbor entrance.

There will be differences in the flow to the marina entrance between the proposed project and Alternative 1. Alternative 1, being smaller in size, will have less impact on groundwater flow than the proposed marina. Alternative 2 will have a similar impact to groundwater quality as the proposed project. Alternative 2 may also impact water quality by contributing nutrients and biocides to the groundwater from the golf course. Alternative 3 would result in no change in existing groundwater conditions. Further discussion on groundwater is contained in Section 3.8.1.

Surface Water

There are no significant natural freshwater streams or ponds at the site, but there are brackish anchialine pools. Surface water at the project site will be influenced by rainfall. Runoff typically percolates rapidly through the permeable ground. The proposed project will include some impermeable surfaces, which together with building roofs, will change runoff and seepage patterns.

Alternative 1 is a lower density project that is expected to have proportionally less impact on surface water and runoff patterns and less potential impact on water quality than the proposed project. Alternative 2 would have more impact on surface water quality than the proposed project due to fertilizers and biocides carried by runoff from the golf course. Alternative 3 would result in no change to surface water conditions. Further discussion on surface water is contained in Section 3.8.2.

Nearshore Environment and Coastal Waters

The potential adverse impacts to the marine environment from the proposed project are due to the construction of an 800-slip marina and the resulting inflow of higher salinity seawater and inadequate water circulation, both of which are anticipated to impair water quality to the extent of falling below applicable standards. One possible mitigation measure is to significantly reduce the size of the marina expansion.

The reduced marina size (from 45 to 25 acres) and reduced lagoon acreage in Alternative 1 are expected to result in a proportionate reduction in seawater discharging into the new harbor and increased water circulation. Alternative 2 includes the same marina basin size and is therefore subject to the same factors that are expected to adversely affect water quality.

In the existing Honokōhau Harbor, water quality issues focus on the potential for pollutants, sediments, mixing and discharge into the nearshore marine waters. Before the harbor was constructed, any pollutants entrained within the groundwater were believed to have been diffused over a broad coastline.

The water quality in the proposed harbor depends on several components. These include salinity, nutrients, and sediments that come from the ocean, rainfall runoff, water features with marine animals, and dust. The smaller project offered as Alternative 1 is expected to produce a reduced amount of pollutants and reduce the risk of adverse impact upon water quality.

It is notable that the 45-acre marina basin planned in the proposed project and Alternative 2 only becomes viable from a water quality impact standpoint if the additional brackish groundwater inflow into the new marina exceeds 60 mgd. The resulting flushing from such inflow would be expected to better maintain water quality. However, it is unclear whether 60 mgd of brackish groundwater would be available. As proposed in Alternative 1, reduction of the volume of the new marina basin by 45 percent will significantly improve the flushing and water quality because the lower volume can be flushed by the available groundwater flow.

In addition, there could be higher rainfall runoff from the Alternative 2 golf course into the harbor, because the grassed golf course will be less porous than the natural surface. The golf course will also require relatively high levels of fertilizer, biocides, and irrigation, all of which could contribute to adverse water quality impacts.

Further discussion on nearshore environment and coastal waters is contained in Section 3.9.1.

Anchialine Pools

Anchialine pools are located north of Honokōhau Harbor, and south of the harbor on the project site. The marine life in these pools is sensitive to groundwater quality, and changes due to construction and operation of the project could degrade the viability of the pool ecosystem. In the southern complex, 3 anchialine pools with a combined surface area of $20m^2$ would be eliminated due to the harbor construction in the proposed project and Alternatives 1 and 2.

Predicting the extent of change in groundwater flow is difficult if not impossible even with numerous boreholes and intense sampling. The actual flow of groundwater towards the sea is minimal today, and tidal measurements show that tide fluctuations represent more than 90 percent in actual harbor tides. The fluctuations occur simultaneous with the ocean/harbor tide, which indicate a vertical and horizontal pressure regime between bore hole 6 and the ocean and harbor. Hence, the tides alone create a mixing system that increases salinity, as the flow approaches the point of discharge which will be either the channel or the shore. Another factor that could influence groundwater quality is the increased local recharge from irrigation between the channel and shore. This will add fresh water to the lens locally but is not quantified at this time.

Quantification of these impacts, including the flow of groundwater through each pond, is therefore extremely difficult. The shallow lavas are of the pahoehoe type and have a relatively high horizontal permeability. In surface depressions or undulations, the pahoehoe lavas have a tendency to lose vertical permeability from sedimentation thus restricting water exchange within the individual pools. This is normally reflected in both the salinity and temperature and this information has been adequately studied in the pools.

Changes in groundwater quality may or may not impact biological communities in the anchialine and estuarine environment. In either case, it is important to understand these relationships to effectively manage the resource. If there is significant deviation from the baseline especially in regard to nutrients, pathogens, and toxins, a mitigation plan to determine the cause and take decisive appropriate action will be implemented.

Due to the uncertainty of changes in groundwater flow and quality due to marina construction, the variability in impacts between the proposed project and Alternatives 1 and 2 is unknown at this time. Alternative 3 would result in no change in groundwater flow. While this would eliminate the potential for adverse impacts, Alternative 3 would also continue the pattern of existing degradation related to human activity and the introduction of alien species. Further discussion on anchialine pools is contained in Section 3.9.2.

Marine Fishing Impacts

The proposed marina will increase the number of boats in the area and it is reasonable to assume that a portion of these new boats will engage in fishing activities. The increase in boats in the area would be primarily related to the marlin and tuna / pelagic fishery, coral reefs due to extractive fisheries, and SCUBA activities. The pressure on fish and invertebrate stocks is expected to increase with or without the marina. Harbor expansion provides the opportunity to address existing conditions to consolidate, focus, and fund management and enforcement activities at one location.

Compared to the proposed project, Alternative 1 would result in a 21 percent decrease in boat traffic, thereby lessening the potential for marine fishing impacts. The level of impacts in Alternative 2 would be similar to that of the proposed project. Alternative 3 would result in no change in existing marine fishing conditions, and no opportunity to address already existing pressure on fish and invertebrate stocks. Further discussion on marine fishing impacts is contained in Section 3.9.3.

Cultural and Archaeological Resources

The proposed project will integrate cultural and archaeological resources in the overall development. Archaeological sites recommended for preservation will be preserved, and cultural practices will be encouraged. Kona Kai Ola includes a canoe park, and a cultural park with a focus on Hawaiian maritime cultural heritage of the voyaging canoe. Proposed is a 400-foot shoreline setback that would serve as a buffer between the ocean and developed areas. This coastal area would be protected with a shoreline park with trails and public access parking for walking and shoreline fishing, and a cultural park surrounding the heiau, the cultural sites and ‘Alula for community use.

Alternative 1 would contain all of the cultural archaeological features and the shoreline setback area would be 400 feet in the northern portion of the site and increase to 600 feet in the southern portion. Alternative 2 would preserve cultural and archaeological resources, but does not include a 400-foot shoreline setback. Alternative 3 would result in no change to existing cultural and archaeological resources and no addition of cultural and community facilities and activities. Further discussion on cultural and archaeological resources is contained in, respectively, Sections 4.1 and 4.2.

Noise

Project-generated noise is due to construction equipment and blasting, boats, marina activities, vehicle traffic, and the Kealakehe Wastewater Treatment Plant operations. Alternative 1 would generate less noise impacts due to reduced construction activities, fewer boats, less traffic and less on-site activity. Alternative 2 would also generate less noise due to reduced traffic and less on-site activity, but noise related to the excavation of the marina basin and an increase in the number of boats would be similar to that of the proposed project. Further discussion on noise impacts is presented in Section 4.4.

Socioeconomic Impacts

The proposed project will generate an increase in de facto population of an estimated 5,321 persons due to the increase in hotel and time-share units. The estimated de facto population increase in Alternative 1 is 37 percent less, at 3,363 persons, than the proposed project. The de facto population increase in Alternative 2 is similar to Alternative 1.

Employment in the commercial components will nearly double in Alternative 1, from a stabilized level of 1,429 full-time equivalent (FTE) positions in the proposed project to 2,740 in the Alternative 1.

Under Alternative 1, the total operating economic activity at Kona Kai Ola will increase due to the added commercial space more than off-setting the fewer visitor units, moving upward from $557.6 million per year to circa $814.3 million annually. The total base economic impact resulting from development and operation of Alternative 1 will similarly be higher by between 35 and 45 percent than that of the proposed project.

Alternative 1, which has a reduced marina size of 25 acres, and fewer hotel and time-share units, would have a meaningful market standing, create significant economic opportunities, and provide a net benefit to State and County revenues. From a market perspective, a smaller Kona Kai Ola would still be the only mixed use community in the Keahole to Kailua-Kona Corridor offering competitive hotel and time-share product.

The estimated absorption periods for marketable components of Alternative 1 are generally shorter than those for the same components in the proposed project. Marina slips under Alternative 1 are estimated to be absorbed within 2 years after groundbreaking, as compared with 9 years for absorption of slips in the proposed project. Hotel rooms under Alternative 1 are estimated to be absorbed within 4 years after groundbreaking, as compared with 7 years under the proposed project. Time-share units would be absorbed within 10 years under Alternative 1, while 15 years are projected under the proposed project. Due to the planned increase in commercial facilities under Alternative 1, the absorption period of commercial space is estimated at 14 years, as compared with 8 years for absorption of such facilities under the proposed project.

The State and County will still both receive a net benefit (tax receipts relative to public expenditures) annually on a stabilized basis under the Alternative 1. The County net benefits will be some $12.2 million per year under the Alternative 1 versus $14.9 million under the proposed project. The State net benefits will increase under the Alternative 1 to about $37.5 million annually, up substantially from the $11.4 million in the proposed project.

Due to the lower de facto population at build-out, the effective stabilized public costs for both the State and County will decline meaningfully under the Alternative 1, dropping from $7.7 million annually for the County and $36.5 million for the State, to $4.9 million and $23 million per year, respectively.

Alternative 3 would result in no increase in de facto population and improvement to economic conditions. Further discussion on social and economic impacts are contained in, respectively, Sections 4.5 and 4.6.

Vehicular Traffic

The proposed project will impact the nearby road network that currently is congested during peak traffic times. The proposed project includes roadway improvements that would reduce the impact and improve roadway conditions for the regional community.

Alternative 1 includes the same roadway system improvements as the proposed project, yet would reduce vehicular traffic by 35 percent when compared to the proposed project. Alternative 2 would have similar traffic conditions and roadway improvements as Alternative 1. Alternative 3 would result in no increase in traffic and no roadway improvements.

Marina Traffic Study

The increase in boat traffic due to the proposed 800-slip marina would cause entrance channel congestion during varying combinations of existing and new marina peak traffic flow. Worst case conditions of active sport fishing weekend and summer holiday recreational traffic result in traffic volumes exceeding capacity over a short afternoon period. Mitigation to address boat traffic in the proposed project include widening the entrance channel, traffic control, implementation of a permanent traffic control tower, or limiting vessel size.

Alternative 1 would result in a 21 percent reduction in boat traffic congestion under average existing conditions and ten percent reduction during peak existing conditions. The reduction to 400 slips also reduces the impacts of congestion at the entrance channel, thereby reducing the need for any modifications to the entrance channel.

Alternative 2 would have the same level of boat traffic as the proposed project. Alternative 3 would not meet the demand for additional boat slips and would not generate additional boat traffic. Further discussion on marina traffic is contained in Section 4.8.

Police, Fire and Medical Services

The proposed project will impact police, fire and medical services due to an increase in de facto population and increased on-site activity. Alternatives 1 and 2 would have similar levels of impact as the proposed project due to increased on-site activity. Further discussion on police, fire and medical services are contained, respectively, in Sections 4.10.1, 4.10.2 and 4.10.3.

Drainage and Storm Water Facilities

The proposed project will increase drainage flows, quantities, velocities, erosion, and sediment runoff.

Alternative 1 involves a reduction of the project density that would reduce storm runoff from the various land uses due to a reduction in impervious surfaces associated with hotel and time-share development and to the creation of more open space. However, roadway areas will increase by about 30 percent in Alternative 1. Storm runoff from proposed streets would therefore increase; thus requiring additional drainage facilities and possibly resulting in no net savings. The golf course in Alternative 2 may also change drainage characteristics from those of the proposed project and may not reduce impacts. Alternative 3 would result in no change in existing conditions and no improvements to drainage infrastructure. Further discussion on drainage and storm water facilities is contained in Section 4.10.5

Wastewater Facilities

The proposed development is located within the service area of the Kealakehe WWTP and a sewer system will be installed that connects to the WWTP. The sewer system will be comprised of a network of gravity sewers, force mains, and pumping stations which collect and convey wastewater to the existing Kealakehe WWTP. Project improvements will incorporate the usage of recycled / R1 water. Improvements implemented by the proposed project will also accommodate the needs of the regional service population.

Alternative 1 would generate approximately 10 percent less wastewater flow than the proposed project. Wastewater flow in Alternative 2 is undetermined. Alternative 3 would result in no additional flow, as well as no improvements that will benefit the regional community. Further discussion on wastewater facilities is contained in Section 4.10.6.

Potable Water Facilities

The proposed project average daily water demand is estimated at 1.76 million gallons per day. Existing County sources are not adequate to meet this demand and source development is required. The developer is working with DLNR and two wells have been identified that will produce a sustainable yield that will serve the project. These wells will also serve water needs beyond the project.

Alternative 1 would result in net decrease of about five percent of potable water demand. Alternative 2 may have a lower water demand than the proposed project as long as potable water is not used for irrigation. Alternative 3 would result in no additional flow, as well as no source development that will benefit the regional community. Further discussion on potable water facilities is contained in Section 4.10.8.

Energy and Communications

Regarding Alternative 1, preliminary estimates for electrical, telecommunications, and cable resulted in a net demand load that remains similar to the proposed project. Further discussion on energy and communications is contained in Section 4.10.9.1.

The proposed project will increase the demand for electrical energy and telecommunications. The demand would be reduced in Alternative 1 because the number of boat slips and units would decrease. Similarly, Alternative 2 would have fewer units than the proposed project and therefore reduce energy demands. Further reduction in energy demand for either alternative could be achieved by using seawater air conditioning (SWAC) and other energy reduction measures, as planned by the developer. Further discussion on energy and telecommunications is contained in Section 4.10.9.2.

Water Features and Lagoons

The proposed project includes a brackishwater pond, lagoons, and marine life exhibits supplied by clean seawater. The water features in Alternative 1 would significantly decrease by 74 percent from 19 acres in the proposed project to five acres in Alternative 1. This decrease in water features would result in a corresponding decrease in water source requirements and seawater discharge. Alternative 2 does not include the seawater features. Alternative 3 would result in no additional demand for water source requirements and seawater discharge.

2.2.2 Conformance with Public Plans and Policies

State of Hawai‘i

Chapter 343, Hawai‘i Revised Statutes

Compliance with this chapter is effected, as described in Section 5.1.1 in regard to the proposed project and the alternatives discussed.

- State Land Use Law, Chapter 205, Hawai‘i Revised Statutes

  The discussion in Section 5.1.2 is directly applicable to Alternative 1, the proposed project. Alternative 1 will involve a setback of 400 feet that increases to 600 feet along the southern portion of the project site’s shoreline area. Alternative 2 does not provide for such a setback, but may still require approvals from DLNR for cultural, recreational, and community uses and structures within the Conservation district.

- Coastal Zone Management Program, Chapter 205A, Hawai‘i Revised Statutes

  Recreational Resources:

  In addition to the discussion of consistency with the associated objective and policies, as described in Section 5.1.3, the reduction from the proposed project’s 800-slip marina to a 400-slip marina under Alternative 1 will still expand the region’s boating opportunities and support facilities. The existing harbor entrance will still be utilized under this alternative; however, potential risks relating to boat traffic and congestion in the marina entrance area will be reduced significantly. The 400-600 foot shoreline setback, public parks, trails, cultural areas, community facilities, and marine science center remain important recreational components under Alternative 1.

Alternative 2 includes a golf course component, which would add a more passive recreation to the active and social components, such as boating, fishing, swimming, trails, walkways, parks, marine life, educational and interactive areas that are also part of the project. The golf course would enhance the range of leisure and recreational opportunities offered at Kona Kai Ola.

Alternative 2, like the proposed project, will expand the region's boating opportunities and support facilities through its 800-slip marina. However, the potential adverse impacts of increased boat traffic from the size of the marina are significant enough to offset the benefits of increased boating opportunities.

Coastal Ecosystems:

The discussion in Section 5.1.3 is directly applicable to Alternative 1.

Alternative 1 not only reduces the number of slips proposed by 50 percent, but it also reduces the size of the marina from 45 acres to 25 acres. The 25-acre marina will increase the body of water within the existing harbor, but to a significantly lesser extent than the proposed project's estimated increase, which is also applicable to the 45-acre size that is proposed for the marina under Alternative 2.

The findings of the Harbor Water Quality Modeling Study conclude that a reduction in the size of the harbor expansion is an alternative that will mitigate the risk of significant impacts upon water quality within the marina and existing harbor. Accordingly, the reduction in both the number of slips and the size of the marina basin under Alternative 1, in combination with proper facilities design, public education, and enforcement of harbor rules and regulations, would result in fewer long-term impacts to water quality and coastal ecosystems. Short-term (construction-related) impacts would likely remain the same although the reduction in the total acreage of excavation is expected to result in a shorter duration of such impacts.

In addition to its 800-slip marina and potential adverse impacts upon water quality and the marine environment, Alternative 2 includes a golf course component, which has the potential to impact coastal ecosystems by increasing the nutrient loading in surface runoff and groundwater and also by introducing pesticides, herbicides, and other chemicals common in golf course use and management into the nearshore waters surrounding the project site.

Economic Uses

Although reduced in the number of slips, the smaller marina under Alternative 1 will nevertheless serve public demand for more boating facilities in West Hawai‘i and is consistent with the objective and policies and discussion set forth in Section 5.1.3. The economic impacts of Alternative 2, while comparable to those of the proposed project's marina development, are notably marginal as to the golf course component, based on the marketability analysis that indicates a condition of saturation within the region.

Coastal Hazards

The discussion and considerations set forth in Section 5.1.3 are also applicable to Alternatives 1 and 2 and indicate compliance with the objective and policies addressed. Tsunami risks mainly affect the large shoreline setback area that is proposed for the project and Alternative 1. Alternative 2 projects a transient accommodation site that is partially within the tsunami hazard zone and thus carries a higher hazard risk. However, the essential requirement for these alternatives, as well as the proposed project, is a well-prepared and properly implemented evacuation plan.

Beach Protection

Discussion and considerations set forth in Section 5.1.3 are also applicable to Alternatives 1 and 2 and indicate compliance with the objective and policies addressed. Alternative 1 and, to a lesser extent, Alternative 2, will retain the shoreline area in its natural condition.

Similar to the proposed project, Alternative 1 provides for a shoreline setback of considerable width within which no structure, except for possible culturally-related structures, would be allowed. Alternatives 1 and 2 will thus be designed to avoid erosion of structures and minimize interference with natural shoreline processes.

Marine Resources

The discussion in Section 5.1.3 is also applicable to Alternative 1 which is described to be an alternative that is specifically projected to mitigate anticipated adverse impacts on water quality and the marine environment that might otherwise result from the original harbor design and scale, which is also incorporated in Alternative 2 . The reduced marina size under Alternative 1 is projected to meet water quality standards and enable greater compliance with the objective and policies addressed in this section.

Alternative 2 includes a golf course component and thus the potential to adversely impact marine resources by increasing the nutrient loading in surface runoff and groundwater and also by introducing pesticides, herbicides, and other chemicals common in golf course use and management into the nearshore waters surrounding the project site.

Hawai'i State Plans, Chapter 226, Hawai'i Revised Statutes

Section 226-4 (State goals), 5 (Objectives and policies for population, and 6 (Objective and policies for economy in general):

The discussion in Section 5.1.4 is applicable to Alternatives 1 and 2, in addition to the proposed project. These development concepts generally conform to the goals, objectives, and policies set forth in these sections because they will provide some degree of economic viability, stability, and sustainability for future generations. Kona Kai Ola will convert essentially vacant land into a mixed-use development with a distinctive marina and boating element, providing a wide range of recreational, business, and employment opportunities to the community.

Section 226-8 Objective and policies for the economy – the visitor industry:

Alternatives 1 and 2 will be consistent with the State's economic objective and policies relating to the tourism industry for the same reasons that are discussed in regard to the proposed project in Section 5.1.4. They will incorporate JDI's commitment to sustainability principles in the planning and design of the development concepts in Alternatives 1 and 2. Although the total hotel and time-share unit count is reduced to approximately 1,500 in Alternatives 1 and 2, the transient accommodations component of these alternatives will still further the State's objective and policies for increased visitor industry employment opportunities and training, foster better visitor understanding of Hawai'i's cultural values, and contribute to the synergism of this mixed-use project concept that addresses the needs of the neighboring community, as well as the visitor industry.

Section 226-11 Objectives and policies for the physical environment: land-based, shoreline and marine resources:

Alternative 1 is expected to involve less potential adverse impacts upon these environmental resources than the proposed project. Likewise, and Alternative 2 would have less adverse impact because of its reduction in the size of the marina and in the total hotel and time-share unit count. Alternative 1 carries less potential risk to water quality and related impacts upon the marine environment and anchialine pool ecosystems. Although approximately three anchialine pools are expected to be destroyed, the great majority of pools will be preserved within and outside of the proposed 400-foot shoreline setback.

The golf course component in Alternative 2 has the potential to impact marine resources by increasing the nutrient loading in surface runoff and groundwater and also by introducing pesticides, herbicides, and other chemicals common in golf course use and management into the marina basin and nearshore waters surrounding the project site. It also has the potential to adversely affect the anchialine pools by introducing the chemicals into the pond systems.

Section 226-12 Objective and policies for the physical environment: scenic, natural beauty, and historic resources:

The discussion in Section 5.1.4 is directly applicable to Alternative 1 and describes the compliance with the objective and policies addressed.

The golf course component of Alternative 2 would create a park-like view that would potentially enhance the beauty of the project site and surrounding areas when considered in combination with the existing rugged natural beauty of the area.

Just as with the proposed project, Alternatives 1 and 2 would also be designed to blend with the natural terrain and to honor and protect the cultural history, resources, and practices of these lands.

Section 226-13 Objectives and policies for the physical environment: land, air and water quality:

As stated above, because of the reduction in both the number of slips and the size of the marina basin, with proper facilities design, public education and enforcement of harbor rules and regulations, Alternative 1 is anticipated to cause fewer long-term impacts to water quality than either the proposed project or Alternative 2. Based on the findings of the Harbor Water Quality Modeling Study, water quality resulting from a reduced marina basin size as proposed under Alternative 1 is expected to be similar to existing conditions.

As previously noted, Alternative 2 has the potential to adversely impact water quality by increasing the nutrient loading in surface runoff and groundwater by introducing pesticides, herbicides and other chemicals common in golf course development and maintenance into the marina basin and nearshore waters surrounding the project site.

Section 226-14 Objectives and policies for facility systems - general:

Alternatives 1 and 2 will conform to the objective and policies of this section on the grounds that are discussed in regard to the proposed project in Section 5.1.4. The master-planning and phasing of the project concepts under these alternatives will be coordinated with associated public and private infrastructural planning and related private and public infrastructural financing. The cost of the marina construction and project-related infrastructure is to be borne by the developer, resulting in considerable savings for the public. In addition, the projected lease revenue from these public lands will provide additional public benefits by establishing a revenue stream for capital improvements and maintenance of a range of State facilities.

Section 226-15 Objectives and policies for facility systems - solid and liquid wastes:

In addition to the developer's commitment to sustainable development design, the project will involve upgrades to the County of Hawaiʻi's Kealakehe Wastewater Treatment Plant to meet current needs, as well as the project's future needs. This commitment is applicable to Alternatives 1 and 2, as well as the proposed project that is discussed in Section 5.1.4.

Section 226-16 Objectives and policies for facility systems – water:

The discussion of water conservation methods and the need to secure additional potable water sources in Section 5.1.4 is also applicable to Alternative 1 and demonstrates conformity to the objective and policies for water facilities. Alternative 2 involves greater irrigation demands in regard to its golf course component and greater potable water demands for human consumption than those for Alternative 1. Alternative 2 is expected to face more serious challenges in securing adequate and reliable sources of water.

Section 229-17 Objectives and policies for facility systems – transportation:

Alternatives 1 and 2 will conform to this objective and policies because they will present water transportation opportunities, including the possible use of transit water shuttles to Kailua-Kona, as described in regard to the proposed project in Section 5.1.4.

Section 226-18 Objectives and policies for facility systems – energy:

Alternatives 1 and 2 conform to these objective and policies through the use of energy efficient design and technology and commitment to the use and production of renewable energy to serve the project's needs. Solar energy production, solar hot water heating, and the use of deep cold seawater for cooling systems are currently identified as means of saving substantial electrical energy costs for the community and the developer.

Section 226-23 Objectives and policies for socio-cultural advancement – leisure:

Alternative 1 conforms to this objective and related policies for the reasons offered in Section 5.1.4 in regard to the proposed project. Alternative 1 will be of greater conformity with the policy regarding access to significant natural and cultural resources in light of the 400-600 foot shoreline setback that has been designed for this alternative.

Although it does not propose the considerable shoreline setback that is planned for Alternative 1, Alternative 2 is consistent with this objective and related policies in incorporating opportunities for shoreline-oriented activities, such as the walking trails. In addition, the golf course component adds a more passive recreation alternative to the active and social components, such as boating, fishing, swimming, trails, walkways, parks, marine life educational and interactive areas that are also part of the project. The golf course would enhance the range of leisure and recreational opportunities offered at Kona Kai Ola.

Section 226-25 Objectives and policies for socio-cultural advancement-culture:

The discussion in Section 5.1.4 is relevant to Alternatives 1 and 2 and demonstrate their conformity the objective and policies of this section.

Both alternatives involve the preservation and protection of cultural features that have been identified by the Cultural Impact Assessment and archaeological studies for the project area. Both provide for public shoreline access, and both will continue the policy of close consultation with the local Hawaiian community and cultural and lineal descendants in the planning of cultural resource preservation and protection.

Section 226-103 Economic priority guidelines:

Alternatives 1 and 2 conform to these guidelines for the same reasons that are set forth in Section 5.1.4. They involve private investment in a public project that will create economic diversification through a mix of marina, industrial, commercial, visitor, and cultural facilities. This presents a wide range of entrepreneurial opportunities, long-term employment opportunities, and job training opportunities.

Section 226-104 Population growth and land resources priority guidelines:

As described in Section 5.1.4, the policy support for the proposed project also extends to the similar development concepts considered in Alternatives 1 and 2. Those alternatives conform to the guidelines of this section because they involve an urban development under parameters and within geographical bounds that are supported by the County's General Plan, a preliminary form of the Kona Community Development Plan, the County's Keahole to Kailua Regional Development Plan, and the reality of being located along the primary commercial/industrial corridor between Keahole Airport and Kailua-Kona. As with the proposed project, the development concepts of Alternatives 1 and 2 are essentially alternatives for the implementation and "in-filling" of the urban expansion area in North Kona.

DHHL Hawai‘i Island Plan

This 2002 plan projects DHHL's Honokōhau makai lands for commercial use. As compared to the proposed project and Alternative 2, Alternative 1 presents an expanded commercial component that provides greater compliance with the plan, while addressing certain beneficiaries' concerns about the scale of the marina originally required in the Project. Alternative 2 also conforms to the recommended commercial uses in the makai lands but to a lesser degree than Alternative 1 because of its more limited commercial component. Like the proposed project, its marina size and number of slips raise environmental issues, as more specifically discussed in Part 3, and community concerns.

County of Hawai‘i General Plan

HCGP Section 4 – Environmental Quality Goals, Policies and Courses of Action:

Alternative 1 is consistent with this section. It presents a reduction in both the number of slips and the size of the marina basin that, in combination with proper facilities design, public education and enforcement of harbor rules and regulations, would result in very few long term impacts to water quality. Based on the findings of the Harbor Water Quality Modeling Study, water quality would remain similar to existing conditions.

Alternative 2 is the least consistent with this section. In addition to the potential significant impacts of its 800 slip marina basin, its golf course component has the potential to adversely impact marine resources by increasing the nutrient loading in surface runoff and groundwater and also by introducing pesticides, herbicides and other chemicals common in golf course use and management into the nearshore waters surrounding the project site. It also has the potential to adversely affect the anchialine pools beyond their current conditions by introducing such substances into the pool systems.

HCGP Section 7 – Natural Beauty Goals and Policies:

Alternative 2 conforms to some degree with this section. Its golf course component would create a park-like view that would potentially enhance the beauty of the project site and surrounding areas when considered in combination with the existing rugged natural beauty of the area, as demonstrated in other makai golf courses within the region.

HCGP Section 8 – Natural Resources and Shoreline:

Alternative 1 is most consistent with the goals and policies of this section. It would require considerably less marina excavation than the proposed project and Alternative 2 and would reduce the potential risk of long-term adverse impacts to water quality. Based on the findings of the Harbor Water Quality Modeling Study, water quality would remain similar to existing conditions with the degree of reduction in marina basin size that is proposed under Alternative 1. This reduction is also expected to reduce potential impacts upon anchialine pools and their ecosytems, as well as shoreline and marine resources that are affected by water quality. Alternative 1 also retains the shoreline preservation and protection concepts that are proposed in and described for the Project.

HCGP Section 10 – Public Facilities Goals and Policies:

The discussion in Section 5.2.1. in relation to the proposed project is applicable to Alternatives 1 and 2. Improvements to public facilities are are integral to the Kona Kai Ola development. The provision of additional boat slips and numerous road improvements, including a makai extension of Kuakini Highway south to Kailua-Kona are incorporated into plans for the project's development. In light of these elements, Alternatives 1 and 2 are consistent with the goals and policies of this section.

HCGP Section 11 – Public Utility Goals, Policies:

As with the proposed project, Alternatives 1 and 2 are consistent with the goals and policies of this section, based on the relevant grounds set forth in Section 5.2.1. The developer is committed to design, fund, and develop environmentally sensitive and energy efficient utility systems to the extent possible, as described previously in Part 5. Its master planning provides for the coordinated development of such systems with the objective of achieving significant savings for the public. As previously-mentioned example, the project development involves the upgrading of the Kealakehe Wastewater Treatment Plant.

HCGP Section 12 – Recreation:

Alternative 1 is consistent with the goals, policies, and courses of action for North Kona in this section.

Although the number of slips is reduced under Alternative 1, the region's boating opportunities and support facilities will still be expanded. The existing marina entrance would still be utilized under this alternative. However, concerns relating to increased activity leading to increased congestion in the marina entrance area would be mitigated to a certain extent. The 400-600 foot shoreline setback, public parks, trails, cultural areas, community facilities and marine science center remain important components of Alternative 1.

The golf course component of Alternative 2 would add a more passive recreation to the active and social components, such as boating, fishing, swimming, trails, walkways, parks, marine life, educational and interactive areas that are also part of the project. The golf course would enhance the range of leisure and recreational opportunities offered at Kona Kai Ola. Alternative 2 is also considered to be consistent with this section.

HCGP Section 13 and 13.2 – Transportation:

The reduced marina component under Alternative 1 will still provide transportation opportunities and provide for possible use of transit water shuttles to Kailua-Kona, although to a lesser degree than under the proposed project and Alternative 2 . However, in each scenario, internal people-movers are planned, and numerous roadway improvements are planned for coordination with public agencies, including but not limited to the construction of the Kuakini Highway extension between Honokōhau and Kailua-Kona. Accordingly, both Alternatives 1 and 2 are consistent with the goals, policies, and courses of action for North Kona under these sections of the General Plan.

HCGP Section 14.3 – Commercial Development:

For the reasons presented in the discussion under Section 226-104 of the State Plan, the planned commercial component under Alternatives 1 and 2 are consistent with this section.

HCGP Section 14.8 – Open Space:

Alternatives 1 and 2 are consistent with the goals and policies of this section. Alternative 1 provides a considerable (400-600 foot) shoreline setback along the entire ocean frontage of the project site as a means of protecting the area's scenic and open space resources, as well as natural and cultural resources. Although it does not incorporate the shoreline setback planned in Alternative 1, Alternative 2 provides a golf course component would contribute to the amount of open space that is currently proposed and allow additional view corridors to be created.

Community Development Plans

Community development plans are being formulated for different regions in the County in order to supplement the County's General Plan. The Kona Kai Ola project is located in the Kona Community Development Plan (CDP) area. Maps associated with the preliminary work phases

of the Kona CDP include the Kona Kai Ola project site within the “Preferred Urban Growth” boundary of the North Kona district. The Kona CDP process is guided by a Steering Committee composed of a broad cross-section of the community. The Steering Committee will eventually complete its work and recommend the CDP’s adoption.

After the DEIS was published, the Kona CDP has progressed to the development of plans for the major urban growth corridor north of Kailua-Kona. The Kona CDP has produced a draft plan showing a transit oriented development that includes a midlevel public transit corridor along the mauka residential elevation, and a makai transit corridor that runs along a proposed new frontage road just makai and parallel to Queen Kaahumanu Highway. The development plan for Alternative 1 includes the Kuakini Highway as part of this proposed frontage road and transit line from Kailua Kona to the Kealakehe area, along with a transit stop at Kona Kai Ola. The Alternative 1 plan also includes a road that could be extended to be part of the proposed frontage road should it be approved and implemented. In addition, the Kona CDP has continued to emphasize the principles of smart growth planning with mixed use urban areas where people can live, work, play and learn in the same region. Kona Kai Ola has been specifically designed to be consistent with this policy in order to provide a stable employment base close to where people live in the mauka residential areas already planned for DHHL and HHFDC lands.

It should be noted that currently and over the years, the 1990 Keāhole to Kailua Development Plan (K-to-K Plan) guides land use actions by the public and private sectors. It is intended to carry out the General Plan goals and policies related to the development of the portion of North Kona area, including the Kona Kai Ola site. The “Preferred Growth Plan” of the Keāhole to Kailua Development Plan identifies the project site as a new regional urban center to include commercial, civic, and financial business related uses, an expanded “Harbor Complex,” a shoreline road, and a shoreline park. The proposed project and the development concepts in Alternatives 1 and 2 are therefore consistent with the recommendations in the Keāhole to Kailua Development Plan.

Hawai‘i County Zoning

As shown on Figure AA, the project site is zoned “Open”. Under Section 25-5-160 of the Hawai‘i County Code, “The O (Open) district applies to areas that contribute to the general welfare, the full enjoyment, or the economic well-being of open land type use which has been established, or is proposed. The object of this district is to encourage development around it such as a golf course and park, and to protect investments which have been or shall be made in reliance upon the retention of such open type use, to buffer an otherwise incompatible land use or district, to preserve a valuable scenic vista or an area of special historical significance, or to protect and preserve submerged land, fishing ponds, and lakes (natural or artificial tide lands)”.

Some of the proposed uses at Kona Kai Ola are permitted uses in the Open zone such as:

- Heiau, historical areas, structures, and monuments;
- Natural features, phenomena, and vistas as tourist attractions;
- Private recreational uses involving no aboveground structure except dressing rooms and comfort stations;

- Public parks;
- Public uses and structures, as permitted under Section 25-4-11.

In addition to those uses permitted outright, the following uses are permitted after issuance of a use permit:

- Yacht harbors and boating facilities; provided that the use, in its entirety, is compatible with the stated purpose of the O district.
- Uses considered directly accessory to the uses permitted in this section shall also be permitted in the O district.

The proposed time-share and hotel units and commercial uses would not be consistent with the zoning designation of "Open". Project implementation therefore requires rezoning of portions of the project to the appropriate zoning category or use permits for certain uses.

Special Management Area

As shown in Figure AB, the entire project area up to the highway is within the coastal zone management zone known as the Special Management Area ("SMA"). At the County level, implementation of the CZM Program is through the review and administering of the SMA permit regulations. Kona Kai Ola complies with and implements the objectives and policies of the Coastal Zone Management (CZM) Program, and a full discussion is provided in Section 5.1.3. The development concepts in the proposed project and Alternatives 1 and 2 will be subject to applicable SMA rules and regulations.

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Regional Office
1601 Kapiolani Blvd., Suite 1110
Honolulu, Hawaii 96814-4700
(808) 944-2200 • Fax (808) 973-2941

FEB 0 6 2007

Mr. Scott Condra
Jacoby Development Inc.
171 17th St., Suite 1550
Atlanta, GA 30363

Dear Mr. Condra:

This letter serves as comment on the Draft Environmental Impact Statement (DEIS) for the proposed Kona Kai Ola development project on the Big Island of Hawai'i. The National Marine Fisheries Service, Pacific Islands Region (NMFS), is concerned about how the development may affect four marine species protected under the Endangered Species Act (ESA) that frequent the area in question: the threatened green sea turtle (*Chelonia mydas*), and the endangered hawksbill sea turtle (*Eretmochelys imbricata*), Hawaiian monk seal (*Monachus schauinslandi*), and humpback whale (*Megaptera novaeangliae*). We are also concerned about impacts this development may have on Hawaiian spinner dolphins (*Stenella longirostris*), which are not listed under the ESA but are protected under the Marine Mammal Protection Act (MMPA).

<u>Species That May be Affected</u>
Green turtles are commonly seen on the Kona coast, both foraging on marine algae and hauling out on sandy beaches to rest. The DEIS incorrectly states that "Green sea turtles are on the EPA protected species list due to their resemblance to Hawksbill turtles" (Appendix Q, p.6). The Recovery Plan for U.S. Pacific Populations of the Green Turtle (NMFS and U.S. Fish and Wildlife Service 1998) states " Green turtles were originally listed under the ESA because of overexploitation for commercial and other purposes, the lack of adequate regulatory mechanisms and effective enforcement, evidence for declining numbers, and habitat loss and degradation" (p.13).

Hawksbill turtles are much less numerous and the population of hawksbills nesting in the Hawaiian Islands is small, occurring mainly on the Big Island of Hawaii. Both species of sea turtles have been documented in the project area, with a total of 186 resident turtles having been individually tagged for identification.

Both humpback whales and Hawaiian monk seals have been documented to occur near or within the project area boundaries. Although the development will not occur within the boundaries of the Hawaiian Islands Humpback Whale National Marine Sanctuary, whales are frequently seen just outside the harbor and could be affected both by construction activities and resulting increased boat traffic.

Monk seals have been repeatedly sighted over the past 10 years, accounting for 74 sightings in the area between Kaiwi Point and Wawahiwaa Point. At least 7 known individuals have been sighted on multiple occasions, and at least one birth has occurred in the area at Makalawena in

2003 (PIFSC 2006). The most recent report of a monk seal occurred just south of Kaloko Point on December 31, 2006.

Hawaiian spinner dolphins are known to use shallow, sandy-bottom bays as daytime habitat, where they can safely rest and socialize while avoiding predators (sharks). The DEIS incorrectly states that "Honokohau Bay is an occasional resting area of a pod of spinner dolphins during the morning and afternoon periods" (Appendix Q, p.2). The area of Honokohau Harbor has been documented to be one of the primary spinner dolphin resting areas on the Kona coast. NMFS is currently in the process of promulgating regulations to protect the resting behavior and habitat of these animals from increasing incidences of human disturbance. We are concerned that this important resting habitat could be permanently lost as a result of the impacts of the planned construction and development.

The following specific comments on the DEIS address both the direct and indirect adverse impacts expected to occur to these species as a result of the construction and operation of the planned development:

<u>Noise</u>
The effect of noise on marine mammals has been well-documented in scientific literature. Blasting, excavation, and pile-driving activities could exceed noise thresholds that have been shown to cause significant behavioral changes, and in extreme cases, physical injuries in marine mammals. In addition, this noise could cause prey species (fish) to flee from the area, resulting in the need for seals and dolphins to expend energy in traveling farther to search for food. Increased noise from boat traffic can also affect marine mammal species by interfering with echolocation and communication, and may cause them to abandon the area. We disagree with the notion that the dolphins "are apparently not overtly impacted by vessel traffic noises" (p.54). Scientific research has shown that increased presence of vessels is linked to population declines in bottlenose dolphins (Bejder et al. 2006). Sea turtles may also be disturbed by loud noise and leave the area, although their hearing ability is more limited compared to marine mammals.

<u>Increased Vessel Traffic</u>
The addition of 800 boat slips in the proposed harbor expansion will substantially increase the amount of vessel traffic and the potential risk of boat collisions with turtles, seals, whales, and dolphins at the harbor entrance and along the entire Kona coastline. It must be assumed that all new slips will be occupied by new boats and not just by boats which are currently moored at existing harbors. Some of these will likely be whale- and dolphin-watching tour boats which will also increase human disturbance to these species.

<u>Increased Human Presence</u>
The project is expected to add a total of 5,321 guests/timeshare owners to the area when fully completed. Visitors, more so than year-round residents, are unlikely to understand the impacts of their actions on Hawaii's protected marine species. Even when provided educational materials, many people still do not comprehend that swimming after turtles, dolphins, and seals is a violation of federal laws. For example, visitors to Hanauma Bay on Oahu are regularly observed standing on sensitive corals and chasing or grabbing onto turtles, even though they are required to view a movie before entering the bay which specifically tells them these actions are

prohibited. NMFS is currently trying to address the already unacceptable level of human interactions with spinner dolphins at several locations on the Kona coast. This development will exacerbate the problem by providing yet another avenue for these interactions to take place.

Water Quality

The DEIS acknowledges that an increase in the amount of pollutants entering the harbor is unavoidable as a direct result of the increased number of boats and people using the harbor. This can include heavy metals, petroleum, trash, sewage, runoff from boat washing, and waste from fish cleaning. An increase in marine debris, such as discarded fishing line or nets, can entangle marine species and result in impaired ability to swim and forage for food, injury to appendages, or even death by ingestion or drowning. While use of Best Management Practices may help to minimize some of these impacts, they will not completely eliminate them. In addition, the proposed marine life exhibit ponds will be a point source of nutrient loading into the harbor because they are not designed as closed systems, but will rely upon seawater flowing through them and out into the harbor. In effect, they will function as large aquariums that will be continually flushing the concentration of fish/marine life waste products into the harbor. There is no mention of acquiring a NPDES permit for this. As there is no quantification of the levels of nutrients expected to be discharged from the ponds, we disagree with your assumption that "The high volume of sea water flowing through the exhibits into the harbor basin will dilute any pollutants……and will be a positive impact on the nearshore marine environment" (p.106). Effects on the surrounding waters may include promoting harmful algae blooms and increased Biological Oxygen Demand (BOD), which can adversely impact corals as well as prey species such as fish, sponges, and sea grasses.

Overload of Existing Moorings

With the increase in the number of vessels at the harbor, an increase in the demand for mooring at various dive/snorkel/fishing sites on the Kona coast can be expected. Because there are a limited number of existing moorings available, this increased demand could result in some boats anchoring offshore and damaging reefs or other important foraging habitat, including Essential Fish Habitat.

Conclusions

In view of the magnitude and duration of the combined impacts of this project on multiple protected marine species, and the complete lack of analysis of the effects on the spinner dolphin population in particular, we strongly disagree with the statement in the executive summary that "No endangered or threatened fauna are expected to be impacted by the project" (p.iii). Since the DEIS does disclose some of these impacts, it is evident that this statement is inconsistent with the facts. A more thorough analysis should be conducted on the effects of this project to ESA-listed threatened and endangered marine species as well as to MMPA-protected marine mammals known to occur in the area.

The DEIS indicates that you plan to apply for a section 404 permit under the Clean Water Act from the Army Corps of Engineers (ACOE). If any effects whatsoever, including beneficial effects, are expected to occur to sea turtles, humpback whales, or Hawaiian monk seals as a result of this project, the ACOE will be required to consult with NMFS under section 7 of the ESA and may need to obtain an incidental take statement before issuing the section 404 permit.

In addition, any adverse impacts to Essential Fish Habitat would require consultation with NMFS under the Magnusen-Stevens Fisheries Conservation and Management Act. We therefore recommend that you meet with staff from both our Protected Resources and Habitat Conservation divisions to assure that these requirements will be met.

Thank you for working to protect our nations living marine resources. If you have any questions regarding these comments, please contact Jayne LeFors on my staff at (808) 944-2277 or at the e-mail address Jayne.LeFors@noaa.gov.

Sincerely,

Chris E. Yates
Assistant Regional Administrator
for Protected Resources

cc: Linda Chinn, Department of Hawaiian Homelands
✓ Dayan Vithanage, Oceanit
Genevieve K.Y. Salmonson, Office of Environmental Quality Control
Sallie Beavers, Kaloko-Honokohau National Historic Park
Peter Young, Department of Land and Natural Resources

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July 23, 2007

Chris E. Yates, Assistant Regional Administrator
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Dear Mr. Yates:

Subject: Kona Kai Ola Draft Environmental Impact Statement
Response to Your Comments Dated February 6, 2007

Thank you for your comments on the Kona Kai Ola Draft Environmental Impact Statement. Your letter contains comments related to project impacts on mammals and sea turtles in terms of noise, increased vessel traffic, increased human presence, water quality, and overload of moorings. This letter responds to these comments.

Noise impacts on mammals and sea turtles

In response to DEIS comments, Marine Acoustics, Inc., (MAI) was retained to conduct three studies, as follows:

- Description of Marine Mammal and Sea Turtles
- Ambient Noise Measurements and Estimation Study
- Acoustic Analysis of Potential Impacts

These studies have significantly increased the EIS discussion on the affected marine environment and noise impacts that may be generated by the proposed project. The findings of these studies are summarized in Section 3.9.4, Marine Mammals and Sea Turtles, and we are including that text in Attachment 1 of this letter. Copies of these studies were provided to your agency in a recent meeting with MAI and Oceanit.

EIS text has been revised to clarify and expand information on the affected environment, and discusses sea turtles, humpback whales, Hawaiian monk seals and dolphins.

The analysis of noise impacts related to construction activities was based on the best available scientific, environmental, geologic, and meteorological data were obtained and used to calculate the acoustic transmission loss (TL) and subsequently to predict the received levels (RLs) at the five receiver sites. State of the art acoustic propagation models were employed in this analysis to determine in-air and in-water TL. MAI used the Acoustic Integration Model© (AIM) to assess the impact of the predicted acoustic sound field on the species of marine mammals that could conceivably occur near the Kona Kai Ola project site.

The study determined that the criteria for Level A impacts to marine mammals for either in-air or in-water conditions at the receiver sites were never exceeded for the model source and receiver locations for non-blasting activities. However, these thresholds could be exceeded by the explosive blasting used to create the new harbor. For both in-air or in-water acoustic propagation, this only occurred when an animal was within about 200 meters (656 ft) of the explosion. This condition could only occur when the explosive source was at locations farthest north in the new harbor and closest to the existing harbor. This condition mandates that a safety range out to at least 200 meters (656 ft) of the source be shown to be clear of all marine mammals and sea turtle prior to each blast to preclude potential Level A takes.

The study explores potential mitigation techniques for this project, and expands those identified in the DEIS. Mitigation measures will be refined during consultations with the National Marine Fisheries Service (NMFS).

Increased boat traffic and increased human traffic

The EIS notes that the project will increase the number of boats, thereby increasing the potential for boat collisions at the harbor entrance and along the coast. While the proposed harbormaster observation hale would help to mitigate this potential, boater education will increase awareness and promote stewardship.

Likewise, programs to educate onsite guests and visitors will help to increase awareness and these efforts will be supplemented by design and management efforts that protect marine species in the onsite water features. Dolphins and seals will not be included in these features.

Water quality

In response to DEIS comments, a Harbor Water Quality Modeling Study was conducted to assess impacts of the project on harbor and nearshore waters. A three dimensional hydrodynamic and water quality model of Honokohau Harbor and its surrounding waters was developed using the Delft3D modeling suite and is described in detail in Appendix U. The model was driven at its offshore boundaries by tidal predictions, and calibrated to reproduce available measurements of water levels, currents, salinity, and temperature.

The water quality model was applied to predict the post-project conditions after the addition of the Kona Kai Ola Marina. Per the Conceptual Master Plan, the marina consists of a 45 acre marina basin with 800 boat slips. Brackish groundwater inflows into the new marina basin were bracketed between 0 mgd and 60 mgd. The two simulated extremes represent scenarios where no additional brackish groundwater will be intercepted by the new marina, which is not consistent with the observed conditions, and when brackish groundwater inflow into the new marina is twice the amount that will be still flowing into the existing marina, respectively.

The model results demonstrated, relative to the increased area, that water quality within the proposed 45-acre marina basin system could not be maintained. Inflow of brackish groundwater to the new marina was found to be fundamental to the flushing and water quality of the proposed system. However, even for the largest simulated inflow of 60 additional mgd entering the new marina, water quality was still degraded post-expansion. This is primarily due to the fact that the proposed marina basin has five times the volume of the existing harbor. In addition, the geometry of the system led to internal circulation between the existing harbor and new marina basin. The 45-acre new marina basin only becomes viable from a water quality impact standpoint if the additional brackish groundwater inflow into the new marina exceeds 60 mgd.

Alternatives to the aforementioned system that could maintain the flushing and water quality, as observed under existing conditions, were investigated. It was found that the reduction of the volume of the new marina basin by 45 percent significantly improved the flushing and water quality.

This study was instrumental in the development of an alternative to the proposed project that includes a 25-acre marina and 400 boat slips. This alternative also includes a reduction of hotel and timeshare units to 1,500 units.

A comparison between impacts related to the proposed project concept and impacts related to this alternative indicates that a reduction in the acreage and number of slips in the marina, as well as the reduction in hotel and timeshare units, would generate less environmental, traffic, social, and economic impacts. Although positive economic impacts would be reduced, this alternative can be considered as a preferable alternative because of reduced environmental impacts. However, while it can be concluded that the 25-acre marina in Alternative 1 would be the preferred size, the DLNR agreement establishes the size of the marina at 45 acres and 800 slips. An amendment to the DLNR agreement is required in order to allow Alternative 1 to proceed. Hence, selection of Alternative 1 is an unresolved issue at this time.

The additional EIS text that includes a discussion of project alternatives that were developed in response to DEIS comments and the harbor water quality modeling study is contained in Attachment 2 of this letter.

Overload of existing moorings

The EIS has been revised to include "Increased numbers of submerged mooring buoys (presently approaching 100) at all dive sites" as a mitigation measure.

Conclusions

The EIS has been revised to include Section 7 consultation as part of the Army Corps of Engineers permit, and the following table has been added:

Agency	Permit or Approval	Requirement	Time Frame
U.S. Army Corps of Engineers	Department of the Army (DOA) Individual Permit	Work in navigable waters; placing fill in waters of the U.S., placing navigation aids Will incorporate: ▪ Rivers and Harbors Act Section 10 ▪ Clean Water Act Sections 401 and 404 ▪ Coastal Zone Management Act Section 307 ▪ Endangered Species Act Section 7 ▪ National Historic Preservation Act Section 106	Prior to any in-water work or fill or placement of navigation aids or modification of terrestrial habitat that may impact species listed under Endangered Species Act
U.S. Coast Guard	Private Aids to Navigation approval	For approval for marking aids to navigation	Prior to placement. Note: placement requires DOA Permit.
State Board of Land and Natural Resources	Easement over Submerged Lands / Shared Harbor Channel Entrance	HRS Section 171-53 (6)	Prior to commencement of operations of new marina
State Department of Business, Economic Development & Tourism	Determination of Hotel Development	HRS Section 171-42	Prior to approval of Master Development Plan

Agency	Permit or Approval	Requirement	Time Frame
State Department of Land and Natural Resources (DLNR) Office of Conservation and Coastal Lands (OCCL)	Conservation District Use Permit (CDUP)	For any work in the conservation district ▪ Kuakini Highway extension and SWAC pipe; Shoreline Park ▪ Hawaiian Cultural Park, Ocean Front Trail	Prior to any work in the conservation district
DLNR Commission on Water Resource Management	Well Construction Permit, Pump Installation Permit	For well construction or ground water source development	Prior to construction or development
State Department of Health (DOH) Clean Water Branch	401 Water Quality Certification	Triggered by DOA permit	Start simultaneously with DOA permit
		NPDES	
	- Individual Permit	Discharge into state waters	Prior to construction
	- NOI Appendix C	Construction activities on one or more acres	Prior to construction
	- NOI Appendix G	Construction dewatering	Prior to construction
	- NOI Appendix L	Discharge of circulation water from decorative ponds	Prior to construction
	All NPDES applications	Copy to DLNR/State Historic Preservation Division	Simultaneously with DOH NPDES submittals
	Zone of Mixing	Include with NPDES for discharge into state waters	Concurrent with NPDES application
DOH Safe Drinking Water Branch	Water Source Approval and capacity demonstration	For new drinking water sources	After source is identified
	Operator Certification	For operators of water systems	Before system use
	Construction Plan Review	For water system improvements and connections	Before construction
	Underground Injection Control (UIC) Permit	For injection well operations	Before operations
DOH Clean Air Branch	Dust control management plan	Recommended only, not required	During construction planning
DOH Noise, Radiation, & Indoor Air Quality Branch	No permit	Comply with Administrative Rules Chapter 11-46, Community Noise Control	During construction

Agency	Permit or Approval	Requirement	Time Frame
	Special Management Area (SMA) Major Permit	Work in the SMA	Prior to any construction or other work in the SMA (does not include DHHL land)
	Zoning	Must be consistent with the General Plan	After acceptance of EIS
County of Hawai‘i	Building Permit	To erect a new structure including fences, swimming pools and retaining walls more than 3’-0" in height, and water catchments regardless of depth or capacity	Prior to construction
	Grading, Grubbing, and Stockpiling Permits	For volumes as specified by county	Prior to activity
	Development, subdivision, drainage and flood zone reviews	For development	Prior to construction

Consultation with NMFS will continue as the project progresses.

Your comment letter and this response are included in the Final Environmental Impact Statement. We appreciate your participation in the environmental review process. Please submit a request to our office if you would like to receive a printed or electronic copy of the Final Environmental Impact Statement, or portions thereof.

Sincerely,

Dayan Vithanage, P.E., PhD.
Director of Engineering

cc: Office of Environmental Quality Control
State Department of Hawaiian Home Lands
Jacoby Development, Inc.

Attachment 1

The increased level of fisheries knowledge has spawned an atmosphere of stewardship in the general charter-boat fishing community. With catch and release programs returning upwards of 40 percent of the Kona catch back to the ocean there is an obvious awareness that the value of catching the fish is often far greater than the value of selling it. It is ~~recommended~~ proposed that facilities and programs to foster continued stewardship, fisheries science, tracking of all fish catch, and educational programs be implemented in the design of the new marina facilities.

The proposed marina, marina support facilities, public marina promenade, fishing club, and marine science center will provide a venue for implementing the following efforts:

- Efforts to promote tag and release will be fostered through public education and the implementation of more "Catch and Release – Only" tournaments.
- Promote management through catch limits to possibly include slot weight catch limits, ~~ie.~~i.e. must tag & release animals between 250–950 pounds
- Promote various other stewardship measures relating to fisheries conservation.

~~3.9.5~~3.9.4 Marine Mammals and Sea Turtles

In addition to water quality, which is discussed in Section 3.9.1.3, other environmental impacts that may affect marine mammals and sea turtles include noise and vessel collisions. The following sections describe existing conditions, potential impacts and suggested mitigations to prevent negative impacts to marine mammals and sea turtles from noise and vessel collisions.

~~3.9.5.1~~3.9.4.1 ~~Existing Conditions~~Affected Environment

A number of marine mammal and turtle species are found in Hawaiian waters near the Kona Kai Ola project site. Detailed information on the abundance, behavior, threats to the species, hearing ability and vocalization data is provided for all species in Appendix S. Data on the most prevalent endangered species and species of particular interest are summarized here.

Humpback Whales: The population of h~~H~~umpback whales (*Megaptera novaeangliae*) around Hawai‘i was estimated to be between ~~are mammals and belong to the baleen whale suborder,~~ ~~*mysticeti*. An estimated~~ 4,500-6,500 in 2000 ~~whales migrate between subpolar Alaska and Hawai‘i each year~~ (Mobley et al 2001). The population growth rate between 1993 and 2000 is estimated to be seven percent indicating that the population is recovering from its dramatic reduction due to commercial whaling. It is worth noting that this is considered a high rate of increase for a mammalian species.

The highest densities of animals are found within the 100 fathom isobath. ~~and seek refuge in shallow waters close to shore.~~ Most humpbacks off Hawai‘i are found north of Honokōhau in the waters of the Hawaiian Islands Humpback Whale National Marine Sanctuary. Nevertheless, they are commonly seen off Honokōhau in winter months. Humpbacks are not deep diving animals. Whales in Hawai‘i typically dive to less than 100 feet, although occasional deeper dives are possible (Hamilton et al. 1997)The whales breed and give birth while in Hawai‘i during the winter months, and migrate north to feed each spring.

~~Humpback whales found in Hawai'i's waters are part of a global population of Humpback whales that was reduced by over 250,000 individuals, or 90 percent, due to hunting (Johnson et al 1984). In 1966, the International Whaling Commission instituted a moratorium on all hunting of whales globally, and populations have begun to rebound. The North Pacific population of humpback whales, with a population of approximately 15,000 prior to hunting, is recovering from an estimated low of 1,000 individuals (Rice 1978, Johnson et al 1984). Humpback whales are also protected under the Federal Endangered Species Act. It is estimated that Hawai'i's population of Humpback whales is growing by 7% annually (Mobley et al 2001).~~

Congress designated the Hawaiian Islands Humpback Whale National Marine Sanctuary (HINMS) on November 4, 1992, and was followed by the Governor of Hawai'i's formal approval in 1997. The Sanctuary's purpose includes protecting humpback whales and their habitat within the Sanctuary, educating the public about the relationship of humpback whales to the Hawaiian Islands marine environment, managing the human uses of the Sanctuary, and providing for the identification of marine resources and ecosystems of national significance for possible inclusion in the Sanctuary. The sanctuary is approximately four nautical miles north of Honokōhau Harbor.

~~While waters surrounding the main Hawaiian islands constitute one of the world's most important North Pacific humpback whale habitats (Calambokidis et al. 1997), the Sanctuary actually encompasses five noncontiguous marine protected areas across the Main Hawaiian Islands, totaling 1370 square miles. Almost half of this area surrounds the islands of Maui, Lāna'i and Moloka'i. Smaller areas are designated on the North shore of Kaua'i, North and Southeast shores of O'ahu, and Hawai'i's Kona Coast. On Hawai'i's Kona Coast, the Sanctuary encompasses the entire northwest-facing coast, consisting of submerged lands and waters seaward of the shoreline to the 100-fathom (183 meter) isobath from 'Upolu Point southward to Keāhole Point, which is approximately four nautical miles north of Honokōhau Harbor.~~

Whales have very sensitive hearing, so any loud underwater sound has ~~may have~~ the potential to disturb these animals. ~~Vessel collisions are also a concern with whales.~~ Playback experiments have estimated that humpback whales will respond to biologically meaningful sound at levels as low as 102 dB re 1 µPa, a level that is similar to background ambient noise (Frankel et al. 1995). Increases in vessel numbers will lead to an increase in noise from operating boats. However, even at its greatest predicted increase, the median sound level from active boats is not expected to raise sound levels to an intensity that would be considered an impact (Level B take) to marine mammal population (See Appendices T-2 and T-3). Humpback whale song ranges from 20 Hz to over 10,000 Hz, with most acoustic energy typically concentrated in the 100-1000 Hz range. This vocal production and the anatomy of their inner ear indicate that these animals are most sensitive to low-frequency sound (Ketten 1992).

Numerous studies have shown that human activity can affect humpback whale behavior, including vessel activity (Bauer 1986; Norris 1994; Corkeron 1995; McCauley et al. 1996; Scheidat et al. 2004), oceanographic research (Frankel and Clark 2000; Frankel and Clark 2002), and sonar (Miller et al. 2000; Fristrup et al. 2003). If the humpback whale population continues to expand at its present rate (8%/year) it can be expected that greater numbers of whales will extend into waters off the Kona Coast. This is likely to increase the demand for whale watching vessels from the new harbor and this increase will have a negative impact on the whale population expansion. The increase in both the number of vessels and number of whales increases the chance for collisions.

Vessel collisions are also a major concern. The majority of whale strikes occur~~red~~ where whales and boats are most common, such as in ~~and boats watching are common as in~~ shallow waters between Lānaʻi and Maui. In a recent study, three of ~~conducted by NMFS on~~ 22 ~~27~~ recorded whale-vessel collisions ~~strikes~~ in the main Hawaiian Islands. ~~, only two were recorded~~ occurred off the Kona coast. (Lammers et al. 2003). That study also found that 14 of the 22 collisions were reported between 1995 and 2003. This observed increase may result from more awareness of the issue, or from the greater number of both whales and vessels in Hawaiian waters. In Hawaiʻi, data from 1972 to 1996 reveal at least six entanglements of humpback whales in commercial fishing equipment (Mazzuca et al. 1998). These data also indicate an increasing trend of entanglement since 1992 and a three-fold increase in death and entanglement occurrences related to human activity in 1996.

It is highly unlikely that humpback whales will approach to within the Level A or Level B impact "take" zones created by the explosive blasts of harbor construction. However, the sounds generated by these explosions will be within the frequency hearing range of humpback whales and could potentially be heard by whales between Kona and Maui. Modeling predicts that the maximum sound level two miles offshore the site is less than 150 dB re1 μPa, which is less than the threshold for Level B impacts. As the explosions are planned to occur daily for up to 9 months, the cumulative impact of this noise must be considered if construction is anticipated when whales are expected in the area (December 15 – March 30).~~In one instance, a fishing boat was pulling in a catch and was lifted by a whale. In the other instance, a whale was struck by a dive boat heading towards its diving spot.~~

Dolphins: A number of dolphin species are found in the waters near Honokōhau Harbor. Detailed information on all of these can be found in Appendix S. Spinner dolphins (*Stenella longirostris*) are regularly seen in shallow water and in close proximity to the project site. ~~Spinner dolphins (*Stenella longirostris*), often inhabit waters within Honokōhau Bay and at times intentionally congregate near the harbor channel to take advantage by bow-riding outgoing vessels. "Spinners" common name stems from their habit of leaping clear of the water and twirling in the air.~~ They are the smallest dolphins typically seen in Hawaiʻi, with a mature size of 6 feet in length and 160 pounds.

Spinners school in pods of a few animals to ~~100~~ 180 or more, with pod sizes of 1-20 being most common (Östman-Lind et al. 2004). They ~~and show community behavior when~~ feed~~ing in~~ on mesopelagic fish, squid and shrimp in deep water at night, and rest in nearshore shallow waters during the day (Norris and Dohl 1980; Benoit-Bird et al. 2001). ~~when they come near shore to play and rest. On the Island of Hawaiʻi, Kealakekua Bay is one location of almost daily spinner visits, but they frequent many other bays along the coast and regularly rest in Honokōhau Bay.~~ There are seven primary resting areas along the Kona coast of Hawaiʻi, including Honokōhau Bay, where spinners are regularly seen near the harbor entrance (Östman-Lind et al. 2004). There is some evidence that the spinner dolphins may be resident to the area (Östman-Lind et al. 2004), making them more susceptible to repeated disturbance.

The hearing ability of spinner dolphins has not been measured. However, hearing of the related striped dolphin (*Stenella coeruleoalba*) was measured between 500 Hz and 160 kHz, with maximum sensitivity at 64 kHz (Kastelein et al. 2003). The hearing response of this single dolphin was less sensitive below 32 kHz than other dolphins. ~~As all marine mammals have very sensitive hearing, any loud underwater sounds have the potential to disturb dolphins as well. Given the sporting habit of spinners and other dolphins of bow-riding ships and small boat wakes, they are apparently not overtly impacted by vessel traffic noises.~~

Despite their limited sensitivity to low frequency sound, spinner dolphins have been shown to be impacted by human activity. Examples include interruption of resting activity and increases in the number of higher energy behaviors (Luna-Valiente and Bazúa-Durán 2006). Numerous studies describe changes in distribution (Haviland-Howell et al. in press) and short-term behavioral changes of dolphins in response to vessel traffic (Bejder et al. 1999; Scarpaci et al. 2000; Gregory and Rowden 2001; Nowacek et al. 2001; Van Parijs and Corkeron 2001; Ritter 2002; Lusseau 2003; Ng and Leung 2003). However, it has been established that for at least one population of bottlenose dolphins, these repeated short-term effects translate into long-term detrimental effects on the affected population (Bejder et al. 2006a; Bejder et al. 2006b).

In Hawaiʻi, some entanglements of spinner dolphins have been observed (Nitta and Henderson 1993; Rickards et al. 2001) but no estimate of annual human-caused mortality and serious injury is available. A habitat issue of increasing concern is the potential effect of swim-with-dolphin programs and other tourism activities focused on spinner dolphins around the main Hawaiian Islands (Östman-Lind et al. 2004).

Hawaiian Monk Seals: Endangered Hawaiian Monk Seals (*Monachus schauinslandi*, Hawaiian Name: ʻIlio holo I ka uaua) ~~are on the endangered species list~~ . ~~They~~ are rare, but not unknown along the Kona Coast. ~~Fortunately, monk seals are air breathing and spend the majority of their time above water where they are easily observed. If a monk seal is reported observed in the area, Kona Kai Ola would work with relevant agencies to protect the seal.~~ Most monk seals are found in the Northwest Hawaiian Islands, but recent aerial surveys estimated that there are 52 seals in the main Hawaiian Islands (Baker and Johanos 2004). There have been 13 sightings between 2003 and 2006 in the vicinity of Kaloko-Honokōhau National Historical Park (NOAA protected species division data) indicating regular, albeit low-level use of these areas by monk seals. ~~One~~Two birth on the Island of Hawaiʻi have~~s~~ been reported (Baker and Johanos 2004).

The best population estimates for Hawaiian monk seals (as of 2003) was 1,244 (Carretta et al. 2004). However the population is currently showing a decline that has been continuing since the 1950s (Antonelis et al. 2006).

Underwater hearing in the Hawaiian monk seal has been measured between 300 Hz to 40 kHz. Their most sensitive hearing is at 12 to 28 kHz, which is a narrower range compared to other phocids. Above 30 kHz, their hearing sensitivity drops markedly (Thomas et al. 1990).

Monk seals are very intolerant of human activity and are easily disturbed. When the U.S. military inhabited Sand Island and the Midway Islands and Kure Atoll, the monk seals disappeared until after the military left. Monk seals prefer to be solitary animals (Reeves et al., 2002).

Sea Turtles: Five species of sea turtles are known to frequent Hawaiian waters, with Hawaiian green sea turtles (*Chelonia mydas*) by far the most abundant at 97% of the total numbers, hawksbill turtles (*Eretmochelys imbricata*, 1.7% of total), olive ridley turtles (*Lepidochelys olivacea*, 0.8%), and occasional sightings of leatherback (*Dermochelys coriacea*) and loggerhead sea turtles (*Caretta caretta*, Chaloupka, et al, 2006, from stranding reports). Green sea turtles are the most plentiful large marine herbivore in the world and have experienced a very successful population recovery in Hawaiian waters since 1974 when harvest was outlawed in Hawai‘~~iH~~i, and 1978 when they became protected under the Endangered Species Act (Balazs, et al. 2004). Both green sea turtles and hawksbills are known to breed and nest on beaches within the main Hawaiian Islands, and have a 25-30 year generation time with a life span of 60-70 years (Balazs et al 2004). Total population numbers of green sea turtles in the Hawaiian archipelago have not been estimated, but the population has at least tripled since the 1970s and may now be approaching the carrying capacity of the islands (Chaloupka, et al. 2006).

Bartol et al. (1999) measured the hearing of juvenile loggerhead sea turtles using auditory evoked potentials to low-frequency tone bursts found the range of hearing to be from at least 250 to 750 Hz. The frequency range that was presented to the turtles was from 250 Hz to 1000 Hz (Bartol et al. 1999).

Most recently, Bartol and Ketten (2006) used auditory evoked potentials to determine the hearing capabilities of subadult green sea turtles and juvenile Kemp’s ridleys. Subadult Hawaiian green sea turtles detected frequencies between 100 and 500 Hz, with their most sensitive hearing between 200 and 400 Hz. However, two juvenile green turtles tested in Maryland had a slightly expanded range of hearing when compared to the subadult greens tested in Hawai‘i. These juveniles responded to sounds ranging from 100 to 800 Hz, with their most sensitive hearing range from 600 to 700 Hz. The two juvenile Kemp’s ridleys had a more restricted range (100 to 500 Hz) with their most sensitive hearing falling between 100 and 200 Hz (Bartol and Ketten 2006).

Adult ~~G~~green turtles are primarily herbivorous often seen on reefs as deep as 100+ feet but much more common in shallower waters. Foraging behavior of green turtles is well documented and in Hawai‘i is typically characterized by numerous short dives (4 to 8 min) in shallow water (typically less than 3 m) with short surface intervals (less than 5 sec) (Rice et al. 1999).Resting periods are characterized by longer dives (over 20 min) in deeper water (4 to 40 m) with surface intervals averaging 2.8 min (Rice et al. 1999). The amount of time that turtles spend foraging versus resting is still largely unknown. Green turtles in Hawai‘i frequently use small caves and crevices in the sides of reefs as resting areas, and spend significant amounts of time on the tops of reefs (Balazs et al. 1987). Green turtles are known to be resident in Kiholo Bay, Hawai‘i (Balazs et al. 2000), and presumably other areas as well, potentially increasing their susceptibility to vessel collision and/or repeated disturbance. Two turtle “cleaning stations” have been reported near the mouth of Honokōhau Harbor. ~~During periods of calm water green sea turtles are often seen over very shallow reef flats where the choicest of algae are to be found. While some turtles may "rest" upon the surface, it is much more common to find them in small caves or wedged between coral heads where they are less subject to shark attacks. Green sea turtles may occasionally be seen far at sea (they nest in French Frigate Shoals in the NW Hawaiian Islands), but they are much more prevalent over the shallow shoreline areas where they forage for food.~~

Vessel collisions and potential noise impacts are a concern with regard to turtles. In a study of 3,861 turtle strandings in the main Hawaiian Islands from 1982 – 2003 (Chaloupka, et al. 2006), boat strikes accounted for only about 2.7 percent of the cases and were almost always fatal (95 percent). Entanglement in gill nets accounted for about six percent of strandings and also had a high rate of mortality (75 perce~~d~~nt). Hook and line entanglement (seven percent of strandings) was much less likely to result in the death of the turtle (52 percent mortality). At least 20 green sea turtles have stranded in Honokōhau Harbor or along the boundaries of Kaloko- Honokōhau National Historical Park. ~~Of all 3,861 strandings recorded in the Main Hawaiian Islands since 1982 only three occurred within 10 miles north or south of Honokōhau Harbor (Balazs, personal communication from NMFS database).~~

Recent increases in longline fisheries may be a serious source of mortality. Greens comprised 14% of the annual observed take of all species of turtles by the Hawai‘i-based longline fishery between 1990 to 1994 (NMFS 1998a). Over the period of 1994 to 1999, it was estimated that an annual average of 40 green sea turtles were caught by the Hawai‘i-based longline fishery (McCracken 2000).

Recent proliferation of a tumorous disease known as fibropapillomatosis (Herbst 1994) may reverse improvements in the status of the Hawaiian stock (NMFS 1998a), although recent modeling suggests that population levels continue to increase despite the disease (Chaloupka and Balazs 2005). The disease is characterized by grayish tumors of various sizes, particularly in the axial regions of the flippers and around the eyes. This debilitating condition can be fatal and neither a cause nor a cure has been identified.

Hawksbill turtles (Eretmochelys imbricate) are observed less often than green sea turtles near Honokōhau. About 20-30 female hawksbills nest annually in the Main Hawaiian Islands (NMFS 1998b). In 20 years of netting and hand-capturing turtles at numerous nearshore sites in Hawai‘i, only eight hawksbills (all immatures) have been encountered at capture sites including Kiholo Bay and Ka‘u (Hawai‘i), Palo‘ou (Moloka‘i) and Makaha (O‘ahu) (NMFS 1998b). It was only recently discovered that hawksbills appear to be specialist sponge carnivores (Meylan 1988). Previously they had been classified as opportunistic feeders on a wide variety of marine invertebrates and algae.

Increasing human populations and the concurrent destruction of habitat are also a major concern for the Pacific hawksbill populations (NMFS 1998b). Hawksbill turtles appear to be rarely caught in pelagic fisheries (McCracken, 2000). However, incidental catches of hawksbill turtles in Hawai‘i do occur, primarily in nearshore gillnets (NMFS 1998b). The primary threats to hawksbills in Hawai‘i are increased human presence, beach erosion and nest predation (*e.g.*, by mongooses) (NMFS 1998b).

~~3.9.5.2~~3.9.4.2 Anticipated Impacts and ~~Recommended~~ Proposed Mitigation

A complete analysis of the in-air and in-water potential acoustic impacts from the construction of the Kona Kai Ola small boat harbor was completed by Marine Acoustics, Inc.(MAI) and is included in this document as Appendix T-3. In conducting this analysis, the best available scientific, environmental, geologic, and meteorological data were obtained and used to calculate the acoustic transmission loss (TL) and subsequently to predict the received levels (RLs) at the five receiver sites. State of the art acoustic propagation models were employed in this analysis to determine in-air and in-water TL. MAI used the Acoustic Integration Model© (AIM©) to assess the impact of the predicted acoustic sound field on the species of marine mammals that could conceivably occur near the Kona Kai Ola project site.

The conclusion of that report determined that the criteria for Level A impacts to marine mammals for either in-air or in-water conditions at the receiver sites were never exceeded for the model source and receiver locations for non-blasting activities. However, these thresholds could be exceeded by the explosive blasting used to create the new harbor. For both in-air or in-water acoustic propagation, this only occurred when an animal was within about 200 meters (656 ft) of the explosion, This condition could only occur when the explosive source was at locations farthest north in the new harbor and closest to the existing harbor. This condition mandates that a safety range out to at least 200 meters (656 ft) of the source be shown to be clear of all marine mammals and sea turtle prior to each blast to preclude potential Level A takes.

The MAI report indicated that the in-air RLs for the explosive sources would exceed the assumed 100 dBA threshold for Level B harassment of pinnipeds (seals) for ranges out to about 0.4 nm (i.e., 800 yds [731 m]). This threshold is nominally for pinnipeds, but it should be extended to surface resting marine mammals and basking or beached sea turtles. Therefore, an in-air safety buffer of at least 731m from any explosive source is proposed, that should be maintained and found clear of marine mammals and basking or beached sea turtles prior to any blasts. It should be noted that although a receiver site was not modeled specifically in the existing harbor, that area is often within the range of this safety buffer and that extra care should be taken to ensure that no marine mammals or sea turtle are in the existing harbor prior to any blast. Analysis of the most restrictive Level B in-water explosive threshold shows that it is only exceeded when an animal is closer than 300 m (984 ft) from the explosive source.

Although the possibility exists for Level B impacts to marine mammals, based purely on the sound fields produced by the explosive blasts, analysis is the marine mammal distribution and movement as predicted by the AIM model, indicates that this is very unlikely situation. Therefore, it is expected that there will be much less than 0.5 Level B takes, with or without mitigation. But the mitigation safety buffer must still be enforced to preclude the unlikely possibility of marine mammals or sea turtle being near the explosive sources when they are used.

It should be recognized that several mitigation measures are already built into the proposed project. For example, the proposed practice to maintain a rock “dam” separating the construction site from the existing harbor reduces acoustic energy propagating to area potentially containing marine mammals or sea turtles. Also, this dam precludes animals from entering the construction area. This dam or land-bridge will be in place for all drilling and dredging activities, except for the removal of the land bridge itself.

Several other possible methods of mitigation are available to the Kona Kai Ola project, and feasibility, practicality, and benefit will be discussed with the National Marine Fisheries Service (NMFS) during consultation, and may be implemented subsequent to that consultation. The first possible mitigation technique is to acoustically monitor the potentially impacted areas during construction to: a) assess the accuracy of the modeling and b) to interact proactively with construction personnel to ensure that the identified threshold levels are not exceeded. Although the best available science and data was used to model the acoustics of the area, numerous conservative assumptions needed to be built into the modeling. By monitoring the actual levels received, in-situ corrections/updates to modeled parameters could potentially reduce the built--in conservativeness and reduce the potentially impacted areas. For example, the modeling assumes that all of the small voids in the bedrock are water-filled and therefore impart minimum attenuation on the acoustic signal as it propagates through. If even a small percentage of the voids are gas-filled, this attenuation would increase greatly and the impacted area would be reduced.

Another possible mitigation technique would be to augment the land-based visual observer, who it is assumed would verify that the area was clear the animals, with boat-based observers. This would increase the effectiveness of recognizing the presence of marine mammals and sea turtles in the potentially affected areas.

Additionally, interactions with the construction teams to alter the blasting methods modeled could potentially mitigate and reduce acoustic impacts to marine animals. A blasting expert will be consulted to develop a discontinuous non-linear blasting plan that will optimize cancellation of the explosion pressure wave into the marine environment. Examples of possible changes include: reducing charge size, reducing the depth drilled and blasted during any blast, reducing the number of blast holes or the volume of each blast, etc. The combination of these techniques with acoustic monitoring could potentially allow a large portion of the northern third of the harbor to be excavated with little or no potential impact to marine animals.

Interactions with NMFS during the consultation period will be used to examine these or any other techniques which may be identified. Also, the project is requesting help in identifying any possible method known to NMFS to establish and maintain turtle exclusion areas, especially in the existing harbor, without harassing the turtles. It may become apparent during those consultations that even with the identified buffer zones and mitigation techniques that an Incidental Harassment Authorization (IHA) is required, especially for the northern third of the proposed harbor.

Marine Acoustics, Inc. also completed a study of the expected ambient noise levels in Honokōhau Bay as a result of the increased vessel traffic from the expanded harbor. This report is included in this document as Appendix T-2. That report concluded that the average maximum daytime ambient noise levels would be expected to increase about 9.7 dB across the frequency spectrum from 100 Hz – 2 kHz, with the quadrupling of the vessels using the expanded harbor (i.e., the proposed action). Although significant, this increase would occur primarily during daylight hours, and the predicted median ambient noise would still be below 100 dB for all frequencies. The other significant factor is that there will be a quadrupling of the number of localized (i.e., small) individual sound fields in the area. These sound fields surround the individual boat that are contributing to the overall ambient noise. Noise levels in excess of 120 dB extend out to about 550 m (1804 ft) from these boats, with even high levels at closer ranges. Short of actual collisions with animals, Level A impacts are unlikely for noise levels typically generated by small boats. The Level B threshold nominally extends to approximately ten meters around each boat (depending on equipment such as size of motor, conditions of propeller and other equipment). Therefore potential Level B impacts to marine mammals and sea turtles would only occur within this range. Therefore, the chance for potential Level B impacts is small.

Completion of the harbor expansion project will increase the vessel traffic crossing the Hawaiian Islands Humpback Whale National Marine Sanctuary, the southern boundary of which is approximately four nautical miles north of Honokōhau Harbor. At a time when the whale population is growing, an increase of vessel traffic may increase the likelihood of vessel-whale collisions. Related to vessel traffic, an increase in whale watching activities is also likely. Vessels participating in these activities directly seek out higher whale population densities, increasing the likelihood of collisions, but also having the potential for disrupting whale behaviors such as resting, courting, mating or birthing.

As noted earlier, however, of the ~~27~~ 22 recorded whale strikes in the main Hawaiian Islands, only ~~two~~ three were recorded off the Kona coast. Sanctuary managers may need to implement additional regulations for private and/or commercial activities directly involving whale encounters. Mariner education programs, already in place as part of Sanctuary operations, will help to mitigate possible impacts due to increased boaters, and the proposed marine science center will complement Sanctuary educational programs.

~~Impacts to turtles may occur during construction of the marina. Since most of the marina will be excavated in a land-locked condition, turtles will not be subject to any potential harm from excavation. Experience during construction of the Ko Olina lagoons, and the expansion of the Barber’s Point Harbor on O‘ahu indicate that turtles abandoned their offshore (30-100 ft depth) resting habitats and concentrated in very near shore waters adjacent to the harbor and, at times, even within the active construction areas as soon as blasting and excavation began. Although no turtle injuries or mortalities were reported during either of those harbor construction activities, this should serve as a cautionary example for future coastal construction activities.~~

An increased level of impacts to turtles from increased boating and fishing activities may occur. ~~The level of impact documented by National Marine Fisheries Service is limited to only three turtle mortalities confirmed, since 1982, from a total of 3,861 strandings throughout the Main Hawaiian Islands~~. Of the 3,861 turtle strandings recorded from the Main Hawaiian Islands since 1982, 75% were mortalities, and of these about 4% (~est. 116, from Figure 3 of Chaloupka, et.al.) were from boat strikes and 3 of these occurred within 10 miles of Honokōhau Harbor. Data from NPS staff at the adjacent Kaloko-Honokōhau National Historical Park show a total of 20 strandings within the parking (19) and harbor (1) between 2000 and 2006 with one attributed to boat strike and 6 to fishing gear entanglement. Eleven additional gear entanglements and one additional boat strike were also recorded but not listed as strandings. Human caused impacts from fishing and boat strikes are anticipated to increase as turtle populations continue to increase and boating /fishing activities increase with the expanding harbor.

~~It would appear that anthropomorphic impact to turtles from boat strikes and fishing activities is very low along the Kona Coast adjacent to the existing harbor. It is likely that this is due in part to the relatively steep ocean bottom that limits the habitat of the turtles to the very nearshore areas away from the areas of heavy boat traffic~~. Recognition by the general public that sea turtles are protected ~~also~~ puts a heavy social pressure on fishermen who may inadvertently catch a sea turtle, and is likely a factor in the recovery of this species. Although no adverse impacts to turtles have been documented within the existing harbor, the close proximity of boats and turtles in this environment is cause for concern.

~~During land-based construction of the marina, no mitigation is necessary as previous experience has shown that turtles are not adversely impacted by these activities.~~ Once the land bridge is open, ~~however,~~ it is highly likely that turtles will be attracted into the new harbor and be subject to potential harm from in-water construction of piers or other facilities. During this period of time and until the harbor is operational, ~~it is recommended that a~~ mesh barrier will be ~~is~~ erected across the new harbor channel to exclude turtles from the inner basin. The mesh size needs to be selected in consultation with ~~regulatory~~ NMFS ~~agencies~~ to make sure it does not entangle turtles.

As the new harbor area will ~~likely~~possibly attract turtles to the basin (similar to the existing harbor) and an increase in boat traffic is expected in the harbor channel there will be an increased possibility of turtle strikes within the channel and new harbor area. To minimize this possibility it is ~~recommended~~ proposed that educational signs be erected around the harbor describing the turtles and warning boaters to be cautious while traversing harbor channels. The slow no-wake lane in the entrance channel should also be strictly enforced and the State should consider extending the slow no-wake zone further out to the first green buoy.

~~As all marine mammals have very sensitive hearing, any loud underwater sounds have the potential to disturb these creatures. Potential underwater acoustics may impact marine mammals and sea turtles during construction activities, such as blasting and pile driving. Appendix Q contains a study of underwater noise impacts during the construction and operation of the proposed project.~~

~~To mitigate impacts related to noise generated by construction activities, such as blasting and pile driving, a program to monitor sound levels and the presence of marine mammals and sea turtles will be implemented. Construction activities will be adjusted if whales, monk seals, dolphins or sea turtles are in the vicinity. Further, keeping the land bridge closed to the ocean until all major pile driving and blasting are completed will further avoid adverse impacts.~~

~~Increased boat traffic will result in increased low intensity sounds in the harbor area and along transit routes. The ecological role played by anthropomorphic sound in the marine environment has recently received heightened awareness. Evidence from declassified Department of Defense ocean recordings off of San Diego show that background sound levels off-shore of the harbor have increased approximately ten-fold in 30 years. Much of this increase in sound level has been ascribed to large ship traffic. While intense sound levels can adversely impact marine mammals and potentially other species, this level of sound pressure has not been shown to be produced by the small boats envisioned to occupy the new marina.~~

~~Adverse impacts of lower intensity noise, such as from small boat engines, have been very difficult to quantify. No definitive information is available to determine the level of impact produced by increase in small boat generated noise on fish, marine mammals and sea turtles. Given the sporting habit of spinners and other dolphins of bow-riding ships and small boat wakes, they are apparently not overtly impacted by vessel traffic noises.~~

~~However, boat-generated noises can be reduced by slowing boats to "slow no-wake" in the main traffic lane of the entrance channel. The State could also consider extending the "slow no-wake" lane out to the first green buoy. Appropriate signage to enforce these requirements is recommended.~~

~~3.9.6~~3.9.5 Ciguatera

Attachment 2

2 Alternatives Analysis

~~In typical land development projects, the initial planning process includes the exploration of alternatives to development objectives. In the EIS process, these alternatives are presented with a disclosure of reasons for the dismissal of non-preferred alternatives.~~

~~Kona Kai Ola does not follow this same pattern of alternatives evaluation.~~ As discussed in Section 1.4, the proposed Kona Kai Ola project is the result of agreements between JDI and the State DLNR and DHHL. The agreements and leases between the State and JDI stipulate the parameters of development for this site in terms of uses, quantities and size of many features, resulting in a limited range of land uses. Unlike a private property project, JDI is required to meet the criteria outlined in the agreements, thereby affording less flexibility in options and uses. From the developer's perspective, the agreements must also provide sufficient flexibility to allow for a development product that responds to market needs and provides a reasonable rate of return on the private investment.

The agreements between JDI and DLNR specify that the proposed harbor basin is to be 45 acres and accommodate 800 slips. This development proposal is the subject of this EIS. In response to DEIS comments, additional water quality studies and modeling were conducted. These studies determined that the water circulation in a 45-acre 800-slip marina would be insufficient to maintain the required standard of water quality. The models of water circulation suggest that a new 25-acre harbor basin could successfully maintain required water quality in the new harbor. Comments on the DEIS from DLNR, from other government agencies, the neighbors and the general community also called for the consideration of alternatives in the EIS, including a project with a smaller harbor basin and less density of hotel and time-share units.

In response to these comments on the DEIS, three alternatives are evaluated in this Final EIS and include Alternative 1, which is a plan with a 25-acre 400-slip harbor basin including a decrease in hotel and time-share units; Alternative 2, which is an alternative that had been previously discussed but not included in the proposed project, that includes an 800-slip harbor and a golf course; and Alternative 3, the no-project alternative. Each alternative is included in the EIS with an evaluation of their potential impacts. These project alternatives are presented to compare the levels of impacts and mitigation measures of the proposed project and alternative development schemes pursuant to requirements set forth in Chapter 343, HRS.

~~JDI is required to provide a new marina basin not less than 45 acres and a minimum of 800 new boat slips. Further, the agreements provide the following options for land uses at the project site:~~

- ~~Golf Course~~
- ~~Retail Commercial Facilities~~
- ~~Hotel Development Parcels~~
- ~~Marina Development Parcels~~
- ~~Community Benefit Development Parcels~~

~~JDI is not pursuing the golf course option and is proposing instead to create various water features throughout the project site. All other optional uses have been incorporated in Kona Kai Ola.~~

2.1 Project Alternatives

2.1.1 Alternative 1: 400-Slip Marina

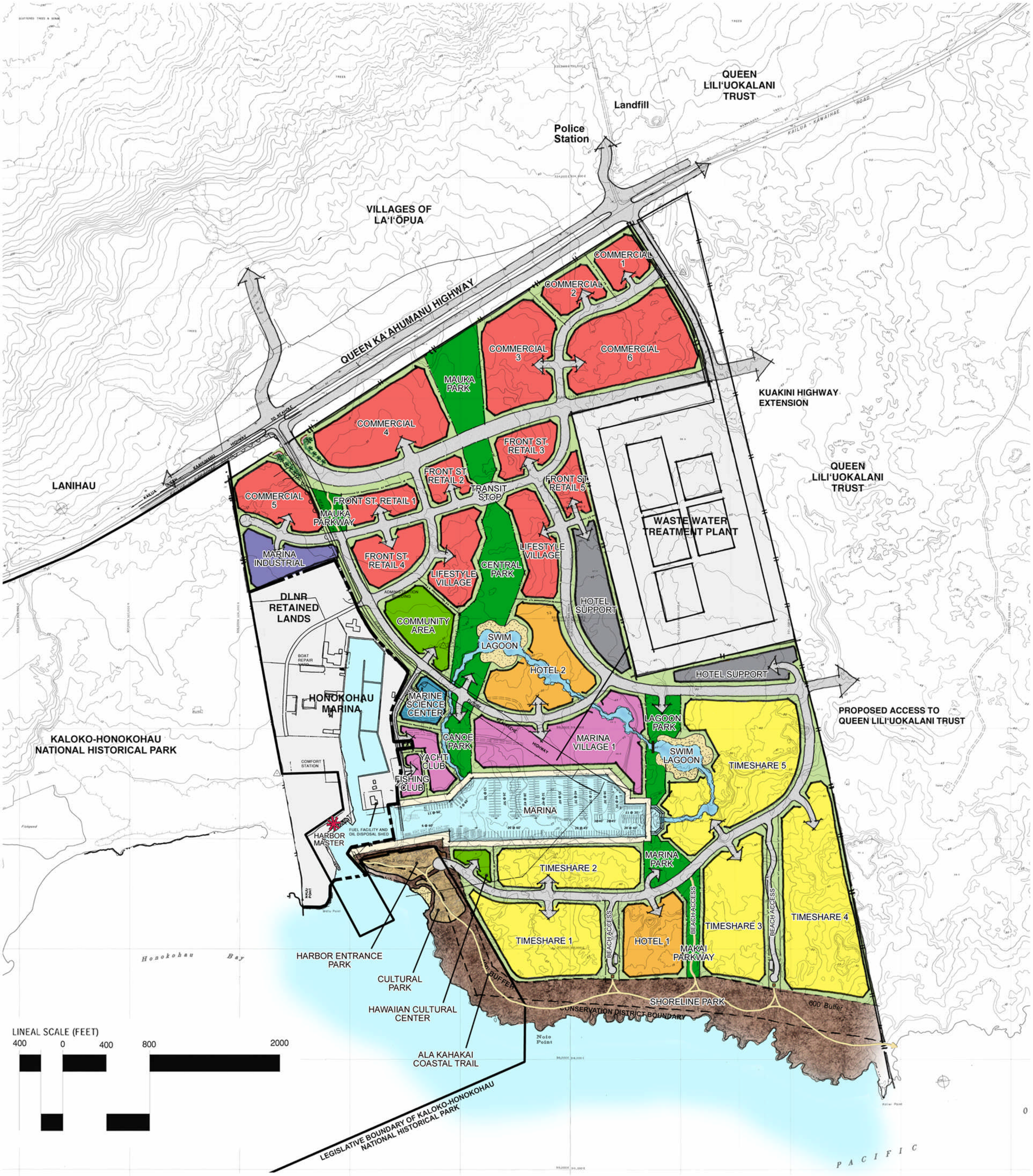
Studies conducted in response to DEIS comments found the construction and operation of an 800-slip marina may significantly impact the water quality within the marina and along the shoreline. Specifically, the Harbor Water Quality Modeling Study, as contained in Appendix U, found that the water circulation in a 45-acre 800-slip harbor was insufficient to maintain an acceptable level of water quality. Further, the existing harbor channel, which would serve both the existing and new harbors, could not adequately serve the increased boat traffic generated by an 800-slip marina during peak traffic. Mitigation measures to accommodate peak boat traffic included the widening of the existing channel, an action that would entail a complex process of Federal and State approvals and encounter significant environmental concern.

Concerns related to the proposed density of hotel and time-share units were also expressed in comments to the DEIS from members of the public, neighbors to the project site, especially the Kaniohale Community Association, and government agencies. Common themes in DEIS comments were related to impacts regarding traffic, project requirements of potable water and infrastructure systems, including sewer, drainage, utility and solid waste systems, and socioeconomic impacts.

In response to the water quality study results, and to the DEIS comments, an alternative plan was developed with a smaller marina with less boat slips, and a related decrease in hotel and time share units. Illustrated in Figure G, Alternative 1 reflects this lesser density project, and features a 400-slip marina encompassing 25 acres. For the purposes of the Alternative 1 analysis, JDI assumed 1,100 time-share units and 400 hotel rooms. Project components include:

- 400 hotel units on 34 acres
- 1,100 time-share units on 106 acres
- 143 acres of commercial uses
- 11 acres of marina support facilities
- 214 acres of parks, roads, open spaces, swim lagoons and community use areas

In addition, Alternative 1 would include the construction of a new intersection of Kealakehe Parkway with Queen Ka‘ahumanu Highway, and the extension of Kealakehe Parkway to join Kuakini Highway to cross the lands of Queen Lili‘uokalani Trust, and connecting with Kuakini Highway in Kailua-Kona. This is a significant off-site infrastructure improvement and is included in the agreements between the State and JDI.



Source: PBR HAWAII

Plan is conceptual only and subject to change

Figure G: Alternative 1: 400-Slip Marina

LEGEND

- TIME SHARE
- HOTEL
- RETAIL / COMMERCIAL
- MARINA RETAIL
- MARINA SUPPORT / COMMERCIAL
- MARINE SCIENCE CENTER
- COMMUNITY AREA / CULTURAL CENTER
- SWIM LAGOON
- MARINA
- UTILITIES
- PARKS & GREEN SPACE
- SHORELINE
- HARBOR ENTRANCE PARK / CULTURAL PARK

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Like the proposed project, Alternative 1 would have a strong ocean orientation, and project components that support this theme would include various water features including seawater lagoons and a marine science center. The new Alternative 1 harbor would include a yacht club, fishing club, a canoe park, and a cultural park with a focus on Hawaiian maritime cultural heritage of the voyaging canoe. The coastal area would be protected with a shoreline park with trails and public access parking for walking and shoreline fishing, and a cultural park surrounding the heiau, the cultural sites and ‘Alula for community use. Additional Alternative 1 community areas would include facilities and space for community use, including programs of the Kona Kai Ola Community Foundation, which supports community programs in health care, culture, education, and employment training for the local community, especially to native Hawaiians. Like the original proposed plan, Alternative 1 includes 40 percent of the land in parks, roads, open spaces, swim lagoons and community use areas.

2.1.2 Alternative 2: Golf Course Feature

Alternative 2 was among the alternatives discussed at a community charrette in September 2003. It includes a golf course, which is a permitted use in the DLNR agreement and DHHL lease. As Figure H illustrates, an 18-hole championship golf course would occupy 222 acres on the southern portion of the project site. As with the proposed project, Alternative 2 includes an 800-slip marina on a minimum of 45 acres.

To support the economic viability of the project, other Alternative 2 uses include:

- Golf course clubhouse on three acres
- 1,570 visitor units on 88 acres fronting the marina
- 118 acres of commercial uses
- 23 acres of community uses

Community uses in Alternative 2 include an amphitheater, a canoe facilities park, a community health center, a Hawaiian cultural center and fishing village, a marine science center and employment training center. The sea water lagoon features contained in the proposed project and Alternative 1 are not included in this alternative.

2.1.3 Alternative 3: No Action

In Alternative 3, the project site would be left vacant, and the proposed marina, hotel and time-share facilities, commercial and marina industrial complexes, and community-oriented uses would not be realized.

~~The economic viability and sustainability of the project is determined by the density and uses proposed. Because JDI is obligated to develop an 800-slip marina for the State, complete road improvements, and provide various public enhancement features at its own expense, the density proposed for the income generating features of the development must be sufficient to provide an acceptable level of economic return for JDI. The market study, which is discussed in Section 4.6, reviewed various development schemes and determined that the currently proposed density and mix is the optimum to meet the anticipated financing and development cost obligations for the public features associated with the development.~~

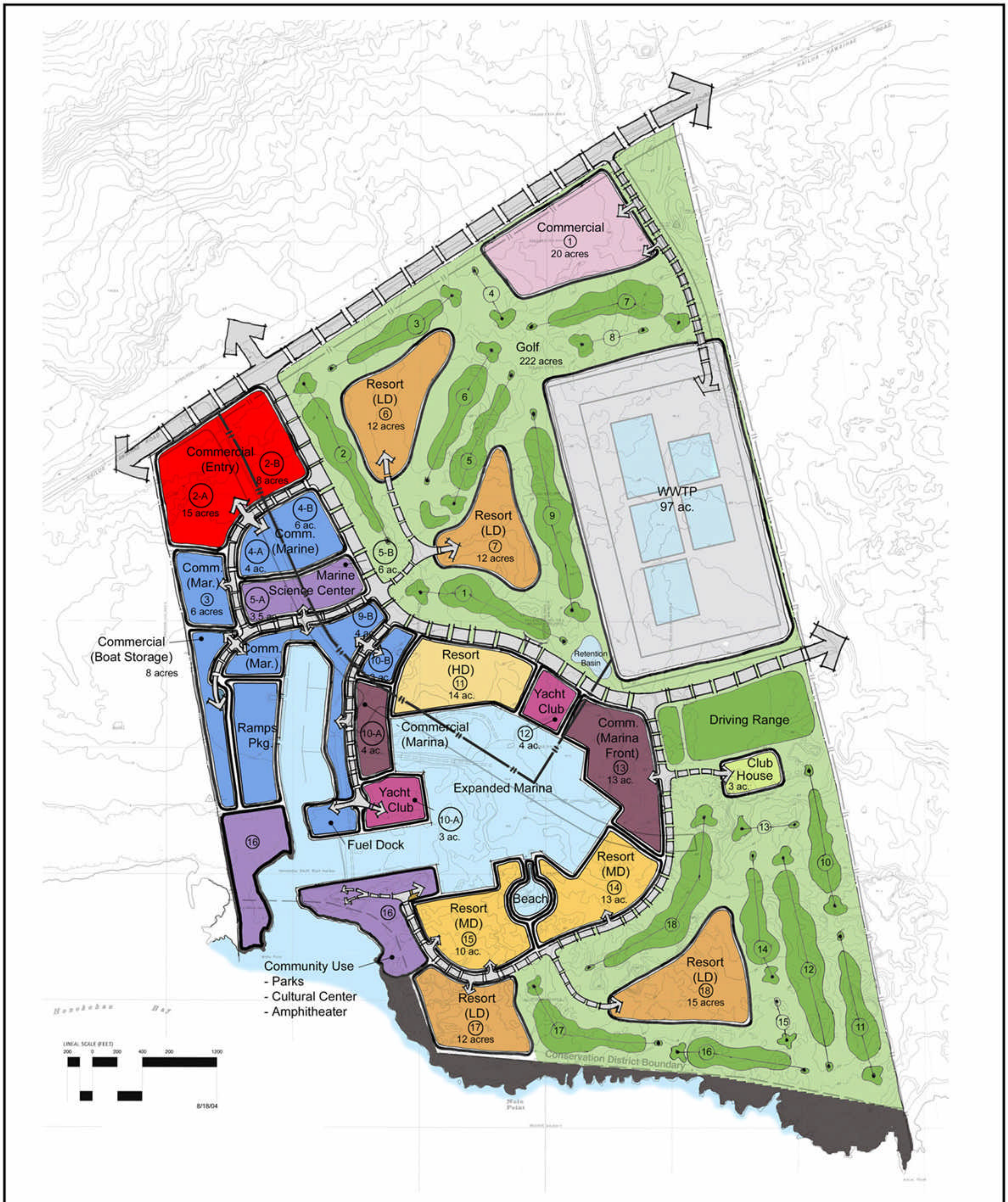

Figure H. Alternative 2: Golf Course Alternative

Legend

N E S W

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2.2 Alternatives Analysis

As discussed in Section 2.1, the proposed Kona Kai Ola project (also referred to as "proposed project") is defined by development requirements related for a marina and the related uses that would be needed to generate a reasonable rate of return that covers development costs.

Beginning with Section 2.2.1, the alternative development concepts are comparatively assessed for potential impacts that may reasonably be expected to result from each alternative. Following is an overview of the primary observations of such assessment.

Alternative 1 includes half of the State-required boat slips and 60 percent of the proposed hotel and time-share units and, due to the decreased density, this alternative would generate significantly less environmental and socio-economic impacts. A harbor water quality model found the reduction of the volume of the new marina basin by about half (approximately 25 acres) significantly improved the water circulation and quality. Further, the reduced number of boat slips would generate less boat traffic, thereby reducing congestion and the need to mitigate impacts further by the widening of the existing harbor channel.

A project with fewer hotel and time-share units and increased commercial space with a longer (14 years) absorption period would change the mix of employment offered by the project, and slightly increase the overall employment count. The public costs/benefits associated with Alternative 1 would change, compared to the proposed project, with a general increase in tax collections, and a general decrease in per capita costs. Detailed discussion of Alternative 1 potential economic impacts are provided in Section 4.6.6. Comparisons of levels of impact are presented throughout this FEIS.

While this analysis might indicate that the 25-acre marina in Alternative 1 would be the more prudent choice, the DLNR agreement establishes the minimum size and slip capacity of the marina at 45 acres and 800 slips, respectively. Amendments to the DLNR agreement would be required in order to allow Alternative 1 to proceed as the preferred alternative. Hence, selection of the preferred alternative is an unresolved issue at the writing of this FEIS.

Alternative 2, the golf course alternative, was not previously considered to be the preferred alternative primarily because market conditions at the time of project development might not likely support another golf course. Further, DHHL has a strategy goal to have more revenue-generating activities on the commercial lease lands within the project area. In addition, concerns have been expressed as to environmental impacts of coastal golf courses, including the potential adverse impact on Kona's water supply if potable water is used for golf course irrigation.

While Alternative 3, the no-project alternative, would not generate adverse impacts related to development of these lands associated with the construction and long-term operations, it would also not allow for an expanded public marina that would meet public need and generate income for the public sector. Further, the no-project alternative would foreclose the opportunity to create a master-planned State-initiated development that would result in increased tax revenue, recreation options and community facilities. Crucial privately-funded improvements, such as the marina, regional roadway and circulation improvements, and improvements to the existing wastewater treatment plant, would not be implemented. Private funds toward the development of community-oriented facilities such as parks, other recreational facilities, and public access would not be contributed.

~~Hence, the only valid alternative to the proposed project is the no-action alternative. In this alternative, the project site would be left vacant, and the proposed marina, hotel and time-share facilities, commercial and marina industrial complexes, and community-oriented uses would not be realized.~~

~~The no-project alternative would therefore not generate adverse impacts associated with the construction and long-term operations would not occur.~~

~~Likewise, the creation of a master-planned state-initiated development, resulting in increased employment, tax revenue, recreation options and community facilities, would not be created. Privately-funded improvements, such as the marina, regional roadway and circulation improvements, and improvements to the existing wastewater treatment plant, would not be implemented. Private funds toward the development of community-oriented facilities such as parks, other recreational facilities and public access would not be contributed.~~

Further, the creation of revenue-producing businesses on the DHHL property to fund homestead programs would not occur, resulting in fewer potential benefits for Hawaiians.

Hence, the agreements and leases between the State and JDI indicate that the no-action alternative is not in the public interest~~has been rejected at this time~~.

2.2.1 Impact Comparison

Grading and Excavation

The proposed project requires grading and excavation. Both actions may impact groundwater due to rainfall runoff during construction. Alternative 1 would require a significantly smaller excavation for the marina basin and would therefore carry a lesser risk of potential adverse effects on water quality. Alternative 2 would require the same basin excavation as the proposed project, and would also include extensive grading and filling to build the golf course, the latter of which would generate additional impacts. Alternative 3 would result in no change to the geography, topography and geology.

Further discussion on grading and excavation is contained in Section 3.3.

Natural Drainage

Most precipitation infiltrates into the porous ground at the site, and no significant sheet flow is likely. Alternative 1 would generate similar levels of impacts on natural drainage as those of the proposed project and thus require similar mitigation measures. The golf course in Alternative 2 would not be as porous since the site would be graded, soil would be placed, and grass and other landscaping would be grown. Sheet flow and runoff can occur on a golf course, and drainage patterns might change. Alternative 3 would result in no change to the existing natural drainage pattern. Further discussion on natural drainage is contained in Section 3.4.

Air Quality

Air quality will be affected by construction activities, as well as pollutants from vehicular, industrial, natural, and agricultural sources. Alternative 1 would generate less construction air quality impacts than the proposed project due to the reduced amount of intensive groundwork associated with the smaller marina basin and fewer long-term impacts by reducing traffic 35 and 40 percent during, respectively, AM and PM peak traffic times. Construction of Alternative 2 would result in fugitive dust and exhaust from equipment and is expected to generate the same level of air quality impact as the proposed project. Alternative 3 would result in no change to existing air quality. Further discussion on air quality is contained in Section 3.5.

Terrestrial Environment

To provide additional habitat for shorebirds and some visiting seabirds, the project proposes to construct a brackishwater pond area suitable for avian fauna, including stilts, coots and ducks. While habitat expansion is beneficial, there is also a possibility that these species may be exposed to activity that may harm them. Alternative 1 would not include a brackish water pond, but will include 5 acres of seawater features, which is 74 percent less than the 19 acres of seawater features in the proposed project. While this would reduce beneficial impacts, it would also decrease exposure to potentially harmful activity. Alternative 2 does not include the brackish water pond features, but would include drainage retention basins that would attract avian fauna and expose them to chemicals used to maintain golf course landscaping. While Alternative 3 would result in no increase in potentially harmful activity, it would also not provide additional habitat for avian fauna. Further discussion on the terrestrial environment is contained in Section 3.7.

Groundwater

Groundwater at the project site occurs as a thin basal brackish water lens. It is influenced by tides and varies in flow direction and salt content. The existing Honokōhau Harbor acts as a drainage point for local groundwater. Any impact to groundwater flow from the proposed harbor is likely to be localized. The proposed marina basin will not result in any significant increase in groundwater flow to the coastline, but rather a concentration and redirection of the existing flows to the harbor entrance.

There will be differences in the flow to the marina entrance between the proposed project and Alternative 1. Alternative 1, being smaller in size, will have less impact on groundwater flow than the proposed marina. Alternative 2 will have a similar impact to groundwater quality as the proposed project. Alternative 2 may also impact water quality by contributing nutrients and biocides to the groundwater from the golf course. Alternative 3 would result in no change in existing groundwater conditions. Further discussion on groundwater is contained in Section 3.8.1.

Surface Water

There are no significant natural freshwater streams or ponds at the site, but there are brackish anchialine pools. Surface water at the project site will be influenced by rainfall. Runoff typically percolates rapidly through the permeable ground. The proposed project will include some impermeable surfaces, which together with building roofs, will change runoff and seepage patterns.

Alternative 1 is a lower density project that is expected to have proportionally less impact on surface water and runoff patterns and less potential impact on water quality than the proposed project. Alternative 2 would have more impact on surface water quality than the proposed project due to fertilizers and biocides carried by runoff from the golf course. Alternative 3 would result in no change to surface water conditions. Further discussion on surface water is contained in Section 3.8.2.

Nearshore Environment and Coastal Waters

The potential adverse impacts to the marine environment from the proposed project are due to the construction of an 800-slip marina and the resulting inflow of higher salinity seawater and inadequate water circulation, both of which are anticipated to impair water quality to the extent of falling below applicable standards. One possible mitigation measure is to significantly reduce the size of the marina expansion.

The reduced marina size (from 45 to 25 acres) and reduced lagoon acreage in Alternative 1 are expected to result in a proportionate reduction in seawater discharging into the new harbor and increased water circulation. Alternative 2 includes the same marina basin size and is therefore subject to the same factors that are expected to adversely affect water quality.

In the existing Honokōhau Harbor, water quality issues focus on the potential for pollutants, sediments, mixing and discharge into the nearshore marine waters. Before the harbor was constructed, any pollutants entrained within the groundwater were believed to have been diffused over a broad coastline.

The water quality in the proposed harbor depends on several components. These include salinity, nutrients, and sediments that come from the ocean, rainfall runoff, water features with marine animals, and dust. The smaller project offered as Alternative 1 is expected to produce a reduced amount of pollutants and reduce the risk of adverse impact upon water quality.

It is notable that the 45-acre marina basin planned in the proposed project and Alternative 2 only becomes viable from a water quality impact standpoint if the additional brackish groundwater inflow into the new marina exceeds 60 mgd. The resulting flushing from such inflow would be expected to better maintain water quality. However, it is unclear whether 60 mgd of brackish groundwater would be available. As proposed in Alternative 1, reduction of the volume of the new marina basin by 45 percent will significantly improve the flushing and water quality because the lower volume can be flushed by the available groundwater flow.

In addition, there could be higher rainfall runoff from the Alternative 2 golf course into the harbor, because the grassed golf course will be less porous than the natural surface. The golf course will also require relatively high levels of fertilizer, biocides, and irrigation, all of which could contribute to adverse water quality impacts.

Further discussion on nearshore environment and coastal waters is contained in Section 3.9.1.

Anchialine Pools

Anchialine pools are located north of Honokōhau Harbor, and south of the harbor on the project site. The marine life in these pools is sensitive to groundwater quality, and changes due to construction and operation of the project could degrade the viability of the pool ecosystem. In the southern complex, 3 anchialine pools with a combined surface area of $20m^2$ would be eliminated due to the harbor construction in the proposed project and Alternatives 1 and 2.

Predicting the extent of change in groundwater flow is difficult if not impossible even with numerous boreholes and intense sampling. The actual flow of groundwater towards the sea is minimal today, and tidal measurements show that tide fluctuations represent more than 90 percent in actual harbor tides. The fluctuations occur simultaneous with the ocean/harbor tide, which indicate a vertical and horizontal pressure regime between bore hole 6 and the ocean and harbor. Hence, the tides alone create a mixing system that increases salinity, as the flow approaches the point of discharge which will be either the channel or the shore. Another factor that could influence groundwater quality is the increased local recharge from irrigation between the channel and shore. This will add fresh water to the lens locally but is not quantified at this time.

Quantification of these impacts, including the flow of groundwater through each pond, is therefore extremely difficult. The shallow lavas are of the pahoehoe type and have a relatively high horizontal permeability. In surface depressions or undulations, the pahoehoe lavas have a tendency to lose vertical permeability from sedimentation thus restricting water exchange within the individual pools. This is normally reflected in both the salinity and temperature and this information has been adequately studied in the pools.

Changes in groundwater quality may or may not impact biological communities in the anchialine and estuarine environment. In either case, it is important to understand these relationships to effectively manage the resource. If there is significant deviation from the baseline especially in regard to nutrients, pathogens, and toxins, a mitigation plan to determine the cause and take decisive appropriate action will be implemented.

Due to the uncertainty of changes in groundwater flow and quality due to marina construction, the variability in impacts between the proposed project and Alternatives 1 and 2 is unknown at this time. Alternative 3 would result in no change in groundwater flow. While this would eliminate the potential for adverse impacts, Alternative 3 would also continue the pattern of existing degradation related to human activity and the introduction of alien species. Further discussion on anchialine pools is contained in Section 3.9.2.

Marine Fishing Impacts

The proposed marina will increase the number of boats in the area and it is reasonable to assume that a portion of these new boats will engage in fishing activities. The increase in boats in the area would be primarily related to the marlin and tuna / pelagic fishery, coral reefs due to extractive fisheries, and SCUBA activities. The pressure on fish and invertebrate stocks is expected to increase with or without the marina. Harbor expansion provides the opportunity to address existing conditions to consolidate, focus, and fund management and enforcement activities at one location.

Compared to the proposed project, Alternative 1 would result in a 21 percent decrease in boat traffic, thereby lessening the potential for marine fishing impacts. The level of impacts in Alternative 2 would be similar to that of the proposed project. Alternative 3 would result in no change in existing marine fishing conditions, and no opportunity to address already existing pressure on fish and invertebrate stocks. Further discussion on marine fishing impacts is contained in Section 3.9.3.

Cultural and Archaeological Resources

The proposed project will integrate cultural and archaeological resources in the overall development. Archaeological sites recommended for preservation will be preserved, and cultural practices will be encouraged. Kona Kai Ola includes a canoe park, and a cultural park with a focus on Hawaiian maritime cultural heritage of the voyaging canoe. Proposed is a 400-foot shoreline setback that would serve as a buffer between the ocean and developed areas. This coastal area would be protected with a shoreline park with trails and public access parking for walking and shoreline fishing, and a cultural park surrounding the heiau, the cultural sites and 'Alula for community use.

Alternative 1 would contain all of the cultural archaeological features and the shoreline setback area would be 400 feet in the northern portion of the site and increase to 600 feet in the southern portion. Alternative 2 would preserve cultural and archaeological resources, but does not include a 400-foot shoreline setback. Alternative 3 would result in no change to existing cultural and archaeological resources and no addition of cultural and community facilities and activities. Further discussion on cultural and archaeological resources is contained in, respectively, Sections 4.1 and 4.2.

Noise

Project-generated noise is due to construction equipment and blasting, boats, marina activities, vehicle traffic, and the Kealakehe Wastewater Treatment Plant operations. Alternative 1 would generate less noise impacts due to reduced construction activities, fewer boats, less traffic and less on-site activity. Alternative 2 would also generate less noise due to reduced traffic and less on-site activity, but noise related to the excavation of the marina basin and an increase in the number of boats would be similar to that of the proposed project. Further discussion on noise impacts is presented in Section 4.4.

Socioeconomic Impacts

The proposed project will generate an increase in de facto population of an estimated 5,321 persons due to the increase in hotel and time-share units. The estimated de facto population increase in Alternative 1 is 37 percent less, at 3,363 persons, than the proposed project. The de facto population increase in Alternative 2 is similar to Alternative 1.

Employment in the commercial components will nearly double in Alternative 1, from a stabilized level of 1,429 full-time equivalent (FTE) positions in the proposed project to 2,740 in the Alternative 1.

Under Alternative 1, the total operating economic activity at Kona Kai Ola will increase due to the added commercial space more than off-setting the fewer visitor units, moving upward from $557.6 million per year to circa $814.3 million annually. The total base economic impact resulting from development and operation of Alternative 1 will similarly be higher by between 35 and 45 percent than that of the proposed project.

Alternative 1, which has a reduced marina size of 25 acres, and fewer hotel and time-share units, would have a meaningful market standing, create significant economic opportunities, and provide a net benefit to State and County revenues. From a market perspective, a smaller Kona Kai Ola would still be the only mixed use community in the Keahole to Kailua-Kona Corridor offering competitive hotel and time-share product.

The estimated absorption periods for marketable components of Alternative 1 are generally shorter than those for the same components in the proposed project. Marina slips under Alternative 1 are estimated to be absorbed within 2 years after groundbreaking, as compared with 9 years for absorption of slips in the proposed project. Hotel rooms under Alternative 1 are estimated to be absorbed within 4 years after groundbreaking, as compared with 7 years under the proposed project. Time-share units would be absorbed within 10 years under Alternative 1, while 15 years are projected under the proposed project. Due to the planned increase in commercial facilities under Alternative 1, the absorption period of commercial space is estimated at 14 years, as compared with 8 years for absorption of such facilities under the proposed project.

The State and County will still both receive a net benefit (tax receipts relative to public expenditures) annually on a stabilized basis under the Alternative 1. The County net benefits will be some $12.2 million per year under the Alternative 1 versus $14.9 million under the proposed project. The State net benefits will increase under the Alternative 1 to about $37.5 million annually, up substantially from the $11.4 million in the proposed project.

Due to the lower de facto population at build-out, the effective stabilized public costs for both the State and County will decline meaningfully under the Alternative 1, dropping from $7.7 million annually for the County and $36.5 million for the State, to $4.9 million and $23 million per year, respectively.

Alternative 3 would result in no increase in de facto population and improvement to economic conditions. Further discussion on social and economic impacts are contained in, respectively, Sections 4.5 and 4.6.

Vehicular Traffic

The proposed project will impact the nearby road network that currently is congested during peak traffic times. The proposed project includes roadway improvements that would reduce the impact and improve roadway conditions for the regional community.

Alternative 1 includes the same roadway system improvements as the proposed project, yet would reduce vehicular traffic by 35 percent when compared to the proposed project. Alternative 2 would have similar traffic conditions and roadway improvements as Alternative 1. Alternative 3 would result in no increase in traffic and no roadway improvements.

Marina Traffic Study

The increase in boat traffic due to the proposed 800-slip marina would cause entrance channel congestion during varying combinations of existing and new marina peak traffic flow. Worst case conditions of active sport fishing weekend and summer holiday recreational traffic result in traffic volumes exceeding capacity over a short afternoon period. Mitigation to address boat traffic in the proposed project include widening the entrance channel, traffic control, implementation of a permanent traffic control tower, or limiting vessel size.

Alternative 1 would result in a 21 percent reduction in boat traffic congestion under average existing conditions and ten percent reduction during peak existing conditions. The reduction to 400 slips also reduces the impacts of congestion at the entrance channel, thereby reducing the need for any modifications to the entrance channel.

Alternative 2 would have the same level of boat traffic as the proposed project. Alternative 3 would not meet the demand for additional boat slips and would not generate additional boat traffic. Further discussion on marina traffic is contained in Section 4.8.

Police, Fire and Medical Services

The proposed project will impact police, fire and medical services due to an increase in de facto population and increased on-site activity. Alternatives 1 and 2 would have similar levels of impact as the proposed project due to increased on-site activity. Further discussion on police, fire and medical services are contained, respectively, in Sections 4.10.1, 4.10.2 and 4.10.3.

Drainage and Storm Water Facilities

The proposed project will increase drainage flows, quantities, velocities, erosion, and sediment runoff.

Alternative 1 involves a reduction of the project density that would reduce storm runoff from the various land uses due to a reduction in impervious surfaces associated with hotel and time-share development and to the creation of more open space. However, roadway areas will increase by about 30 percent in Alternative 1. Storm runoff from proposed streets would therefore increase; thus requiring additional drainage facilities and possibly resulting in no net savings. The golf course in Alternative 2 may also change drainage characteristics from those of the proposed project and may not reduce impacts. Alternative 3 would result in no change in existing conditions and no improvements to drainage infrastructure. Further discussion on drainage and storm water facilities is contained in Section 4.10.5

Wastewater Facilities

The proposed development is located within the service area of the Kealakehe WWTP and a sewer system will be installed that connects to the WWTP. The sewer system will be comprised of a network of gravity sewers, force mains, and pumping stations which collect and convey wastewater to the existing Kealakehe WWTP. Project improvements will incorporate the usage of recycled / R1 water. Improvements implemented by the proposed project will also accommodate the needs of the regional service population.

Alternative 1 would generate approximately 10 percent less wastewater flow than the proposed project. Wastewater flow in Alternative 2 is undetermined. Alternative 3 would result in no additional flow, as well as no improvements that will benefit the regional community. Further discussion on wastewater facilities is contained in Section 4.10.6.

Potable Water Facilities

The proposed project average daily water demand is estimated at 1.76 million gallons per day. Existing County sources are not adequate to meet this demand and source development is required. The developer is working with DLNR and two wells have been identified that will produce a sustainable yield that will serve the project. These wells will also serve water needs beyond the project.

Alternative 1 would result in net decrease of about five percent of potable water demand. Alternative 2 may have a lower water demand than the proposed project as long as potable water is not used for irrigation. Alternative 3 would result in no additional flow, as well as no source development that will benefit the regional community. Further discussion on potable water facilities is contained in Section 4.10.8.

Energy and Communications

Regarding Alternative 1, preliminary estimates for electrical, telecommunications, and cable resulted in a net demand load that remains similar to the proposed project. Further discussion on energy and communications is contained in Section 4.10.9.1.

The proposed project will increase the demand for electrical energy and telecommunications. The demand would be reduced in Alternative 1 because the number of boat slips and units would decrease. Similarly, Alternative 2 would have fewer units than the proposed project and therefore reduce energy demands. Further reduction in energy demand for either alternative could be achieved by using seawater air conditioning (SWAC) and other energy reduction measures, as planned by the developer. Further discussion on energy and telecommunications is contained in Section 4.10.9.2.

Water Features and Lagoons

The proposed project includes a brackishwater pond, lagoons, and marine life exhibits supplied by clean seawater. The water features in Alternative 1 would significantly decrease by 74 percent from 19 acres in the proposed project to five acres in Alternative 1. This decrease in water features would result in a corresponding decrease in water source requirements and seawater discharge. Alternative 2 does not include the seawater features. Alternative 3 would result in no additional demand for water source requirements and seawater discharge.

2.2.2 Conformance with Public Plans and Policies

State of Hawai‘i

Chapter 343, Hawai‘i Revised Statutes

Compliance with this chapter is effected, as described in Section 5.1.1 in regard to the proposed project and the alternatives discussed.

- State Land Use Law, Chapter 205, Hawai‘i Revised Statutes

  The discussion in Section 5.1.2 is directly applicable to Alternative 1, the proposed project. Alternative 1 will involve a setback of 400 feet that increases to 600 feet along the southern portion of the project site’s shoreline area. Alternative 2 does not provide for such a setback, but may still require approvals from DLNR for cultural, recreational, and community uses and structures within the Conservation district.

- Coastal Zone Management Program, Chapter 205A, Hawai‘i Revised Statutes

  Recreational Resources:

  In addition to the discussion of consistency with the associated objective and policies, as described in Section 5.1.3, the reduction from the proposed project’s 800-slip marina to a 400-slip marina under Alternative 1 will still expand the region’s boating opportunities and support facilities. The existing harbor entrance will still be utilized under this alternative; however, potential risks relating to boat traffic and congestion in the marina entrance area will be reduced significantly. The 400-600 foot shoreline setback, public parks, trails, cultural areas, community facilities, and marine science center remain important recreational components under Alternative 1.

Alternative 2 includes a golf course component, which would add a more passive recreation to the active and social components, such as boating, fishing, swimming, trails, walkways, parks, marine life, educational and interactive areas that are also part of the project. The golf course would enhance the range of leisure and recreational opportunities offered at Kona Kai Ola.

Alternative 2, like the proposed project, will expand the region's boating opportunities and support facilities through its 800-slip marina. However, the potential adverse impacts of increased boat traffic from the size of the marina are significant enough to offset the benefits of increased boating opportunities.

Coastal Ecosystems:

The discussion in Section 5.1.3 is directly applicable to Alternative 1.

Alternative 1 not only reduces the number of slips proposed by 50 percent, but it also reduces the size of the marina from 45 acres to 25 acres. The 25-acre marina will increase the body of water within the existing harbor, but to a significantly lesser extent than the proposed project's estimated increase, which is also applicable to the 45-acre size that is proposed for the marina under Alternative 2.

The findings of the Harbor Water Quality Modeling Study conclude that a reduction in the size of the harbor expansion is an alternative that will mitigate the risk of significant impacts upon water quality within the marina and existing harbor. Accordingly, the reduction in both the number of slips and the size of the marina basin under Alternative 1, in combination with proper facilities design, public education, and enforcement of harbor rules and regulations, would result in fewer long-term impacts to water quality and coastal ecosystems. Short-term (construction-related) impacts would likely remain the same although the reduction in the total acreage of excavation is expected to result in a shorter duration of such impacts.

In addition to its 800-slip marina and potential adverse impacts upon water quality and the marine environment, Alternative 2 includes a golf course component, which has the potential to impact coastal ecosystems by increasing the nutrient loading in surface runoff and groundwater and also by introducing pesticides, herbicides, and other chemicals common in golf course use and management into the nearshore waters surrounding the project site.

Economic Uses

Although reduced in the number of slips, the smaller marina under Alternative 1 will nevertheless serve public demand for more boating facilities in West Hawai‘i and is consistent with the objective and policies and discussion set forth in Section 5.1.3. The economic impacts of Alternative 2, while comparable to those of the proposed project's marina development, are notably marginal as to the golf course component, based on the marketability analysis that indicates a condition of saturation within the region.

Coastal Hazards

The discussion and considerations set forth in Section 5.1.3 are also applicable to Alternatives 1 and 2 and indicate compliance with the objective and policies addressed. Tsunami risks mainly affect the large shoreline setback area that is proposed for the project and Alternative 1. Alternative 2 projects a transient accommodation site that is partially within the tsunami hazard zone and thus carries a higher hazard risk. However, the essential requirement for these alternatives, as well as the proposed project, is a well-prepared and properly implemented evacuation plan.

Beach Protection

Discussion and considerations set forth in Section 5.1.3 are also applicable to Alternatives 1 and 2 and indicate compliance with the objective and policies addressed. Alternative 1 and, to a lesser extent, Alternative 2, will retain the shoreline area in its natural condition.

Similar to the proposed project, Alternative 1 provides for a shoreline setback of considerable width within which no structure, except for possible culturally-related structures, would be allowed. Alternatives 1 and 2 will thus be designed to avoid erosion of structures and minimize interference with natural shoreline processes.

Marine Resources

The discussion in Section 5.1.3 is also applicable to Alternative 1 which is described to be an alternative that is specifically projected to mitigate anticipated adverse impacts on water quality and the marine environment that might otherwise result from the original harbor design and scale, which is also incorporated in Alternative 2 . The reduced marina size under Alternative 1 is projected to meet water quality standards and enable greater compliance with the objective and policies addressed in this section.

Alternative 2 includes a golf course component and thus the potential to adversely impact marine resources by increasing the nutrient loading in surface runoff and groundwater and also by introducing pesticides, herbicides, and other chemicals common in golf course use and management into the nearshore waters surrounding the project site.

Hawai'i State Plans, Chapter 226, Hawai'i Revised Statutes

Section 226-4 (State goals), 5 (Objectives and policies for population, and 6 (Objective and policies for economy in general):

The discussion in Section 5.1.4 is applicable to Alternatives 1 and 2, in addition to the proposed project. These development concepts generally conform to the goals, objectives, and policies set forth in these sections because they will provide some degree of economic viability, stability, and sustainability for future generations. Kona Kai Ola will convert essentially vacant land into a mixed-use development with a distinctive marina and boating element, providing a wide range of recreational, business, and employment opportunities to the community.

Section 226-8 Objective and policies for the economy – the visitor industry:

Alternatives 1 and 2 will be consistent with the State's economic objective and policies relating to the tourism industry for the same reasons that are discussed in regard to the proposed project in Section 5.1.4. They will incorporate JDI's commitment to sustainability principles in the planning and design of the development concepts in Alternatives 1 and 2. Although the total hotel and time-share unit count is reduced to approximately 1,500 in Alternatives 1 and 2, the transient accommodations component of these alternatives will still further the State's objective and policies for increased visitor industry employment opportunities and training, foster better visitor understanding of Hawai'i's cultural values, and contribute to the synergism of this mixed-use project concept that addresses the needs of the neighboring community, as well as the visitor industry.

Section 226-11 Objectives and policies for the physical environment: land-based, shoreline and marine resources:

Alternative 1 is expected to involve less potential adverse impacts upon these environmental resources than the proposed project. Likewise, and Alternative 2 would have less adverse impact because of its reduction in the size of the marina and in the total hotel and time-share unit count. Alternative 1 carries less potential risk to water quality and related impacts upon the marine environment and anchialine pool ecosystems. Although approximately three anchialine pools are expected to be destroyed, the great majority of pools will be preserved within and outside of the proposed 400-foot shoreline setback.

The golf course component in Alternative 2 has the potential to impact marine resources by increasing the nutrient loading in surface runoff and groundwater and also by introducing pesticides, herbicides, and other chemicals common in golf course use and management into the marina basin and nearshore waters surrounding the project site. It also has the potential to adversely affect the anchialine pools by introducing the chemicals into the pond systems.

Section 226-12 Objective and policies for the physical environment: scenic, natural beauty, and historic resources:

The discussion in Section 5.1.4 is directly applicable to Alternative 1 and describes the compliance with the objective and policies addressed.

The golf course component of Alternative 2 would create a park-like view that would potentially enhance the beauty of the project site and surrounding areas when considered in combination with the existing rugged natural beauty of the area.

Just as with the proposed project, Alternatives 1 and 2 would also be designed to blend with the natural terrain and to honor and protect the cultural history, resources, and practices of these lands.

Section 226-13 Objectives and policies for the physical environment: land, air and water quality:

As stated above, because of the reduction in both the number of slips and the size of the marina basin, with proper facilities design, public education and enforcement of harbor rules and regulations, Alternative 1 is anticipated to cause fewer long-term impacts to water quality than either the proposed project or Alternative 2. Based on the findings of the Harbor Water Quality Modeling Study, water quality resulting from a reduced marina basin size as proposed under Alternative 1 is expected to be similar to existing conditions.

As previously noted, Alternative 2 has the potential to adversely impact water quality by increasing the nutrient loading in surface runoff and groundwater by introducing pesticides, herbicides and other chemicals common in golf course development and maintenance into the marina basin and nearshore waters surrounding the project site.

Section 226-14 Objectives and policies for facility systems - general:

Alternatives 1 and 2 will conform to the objective and policies of this section on the grounds that are discussed in regard to the proposed project in Section 5.1.4. The master-planning and phasing of the project concepts under these alternatives will be coordinated with associated public and private infrastructural planning and related private and public infrastructural financing. The cost of the marina construction and project-related infrastructure is to be borne by the developer, resulting in considerable savings for the public. In addition, the projected lease revenue from these public lands will provide additional public benefits by establishing a revenue stream for capital improvements and maintenance of a range of State facilities.

Section 226-15 Objectives and policies for facility systems - solid and liquid wastes:

In addition to the developer’s commitment to sustainable development design, the project will involve upgrades to the County of Hawai‘i’s Kealakehe Wastewater Treatment Plant to meet current needs, as well as the project’s future needs. This commitment is applicable to Alternatives 1 and 2, as well as the proposed project that is discussed in Section 5.1.4.

Section 226-16 Objectives and policies for facility systems – water:

The discussion of water conservation methods and the need to secure additional potable water sources in Section 5.1.4 is also applicable to Alternative 1 and demonstrates conformity to the objective and policies for water facilities. Alternative 2 involves greater irrigation demands in regard to its golf course component and greater potable water demands for human consumption than those for Alternative 1. Alternative 2 is expected to face more serious challenges in securing adequate and reliable sources of water.

Section 229-17 Objectives and policies for facility systems – transportation:

Alternatives 1 and 2 will conform to this objective and policies because they will present water transportation opportunities, including the possible use of transit water shuttles to Kailua-Kona, as described in regard to the proposed project in Section 5.1.4.

Section 226-18 Objectives and policies for facility systems – energy:

Alternatives 1 and 2 conform to these objective and policies through the use of energy efficient design and technology and commitment to the use and production of renewable energy to serve the project's needs. Solar energy production, solar hot water heating, and the use of deep cold seawater for cooling systems are currently identified as means of saving substantial electrical energy costs for the community and the developer.

Section 226-23 Objectives and policies for socio-cultural advancement – leisure:

Alternative 1 conforms to this objective and related policies for the reasons offered in Section 5.1.4 in regard to the proposed project. Alternative 1 will be of greater conformity with the policy regarding access to significant natural and cultural resources in light of the 400-600 foot shoreline setback that has been designed for this alternative.

Although it does not propose the considerable shoreline setback that is planned for Alternative 1, Alternative 2 is consistent with this objective and related policies in incorporating opportunities for shoreline-oriented activities, such as the walking trails. In addition, the golf course component adds a more passive recreation alternative to the active and social components, such as boating, fishing, swimming, trails, walkways, parks, marine life educational and interactive areas that are also part of the project. The golf course would enhance the range of leisure and recreational opportunities offered at Kona Kai Ola.

Section 226-25 Objectives and policies for socio-cultural advancement-culture:

The discussion in Section 5.1.4 is relevant to Alternatives 1 and 2 and demonstrate their conformity the objective and policies of this section.

Both alternatives involve the preservation and protection of cultural features that have been identified by the Cultural Impact Assessment and archaeological studies for the project area. Both provide for public shoreline access, and both will continue the policy of close consultation with the local Hawaiian community and cultural and lineal descendants in the planning of cultural resource preservation and protection.

Section 226-103 Economic priority guidelines:

Alternatives 1 and 2 conform to these guidelines for the same reasons that are set forth in Section 5.1.4. They involve private investment in a public project that will create economic diversification through a mix of marina, industrial, commercial, visitor, and cultural facilities. This presents a wide range of entrepreneurial opportunities, long-term employment opportunities, and job training opportunities.

Section 226-104 Population growth and land resources priority guidelines:

As described in Section 5.1.4, the policy support for the proposed project also extends to the similar development concepts considered in Alternatives 1 and 2. Those alternatives conform to the guidelines of this section because they involve an urban development under parameters and within geographical bounds that are supported by the County's General Plan, a preliminary form of the Kona Community Development Plan, the County's Keahole to Kailua Regional Development Plan, and the reality of being located along the primary commercial/industrial corridor between Keahole Airport and Kailua-Kona. As with the proposed project, the development concepts of Alternatives 1 and 2 are essentially alternatives for the implementation and "in-filling" of the urban expansion area in North Kona.

DHHL Hawai‘i Island Plan

This 2002 plan projects DHHL's Honokōhau makai lands for commercial use. As compared to the proposed project and Alternative 2, Alternative 1 presents an expanded commercial component that provides greater compliance with the plan, while addressing certain beneficiaries' concerns about the scale of the marina originally required in the Project. Alternative 2 also conforms to the recommended commercial uses in the makai lands but to a lesser degree than Alternative 1 because of its more limited commercial component. Like the proposed project, its marina size and number of slips raise environmental issues, as more specifically discussed in Part 3, and community concerns.

County of Hawai‘i General Plan

HCGP Section 4 – Environmental Quality Goals, Policies and Courses of Action:

Alternative 1 is consistent with this section. It presents a reduction in both the number of slips and the size of the marina basin that, in combination with proper facilities design, public education and enforcement of harbor rules and regulations, would result in very few long term impacts to water quality. Based on the findings of the Harbor Water Quality Modeling Study, water quality would remain similar to existing conditions.

Alternative 2 is the least consistent with this section. In addition to the potential significant impacts of its 800 slip marina basin, its golf course component has the potential to adversely impact marine resources by increasing the nutrient loading in surface runoff and groundwater and also by introducing pesticides, herbicides and other chemicals common in golf course use and management into the nearshore waters surrounding the project site. It also has the potential to adversely affect the anchialine pools beyond their current conditions by introducing such substances into the pool systems.

HCGP Section 7 – Natural Beauty Goals and Policies:

Alternative 2 conforms to some degree with this section. Its golf course component would create a park-like view that would potentially enhance the beauty of the project site and surrounding areas when considered in combination with the existing rugged natural beauty of the area, as demonstrated in other makai golf courses within the region.

HCGP Section 8 – Natural Resources and Shoreline:

Alternative 1 is most consistent with the goals and policies of this section. It would require considerably less marina excavation than the proposed project and Alternative 2 and would reduce the potential risk of long-term adverse impacts to water quality. Based on the findings of the Harbor Water Quality Modeling Study, water quality would remain similar to existing conditions with the degree of reduction in marina basin size that is proposed under Alternative 1. This reduction is also expected to reduce potential impacts upon anchialine pools and their ecosytems, as well as shoreline and marine resources that are affected by water quality. Alternative 1 also retains the shoreline preservation and protection concepts that are proposed in and described for the Project.

HCGP Section 10 – Public Facilities Goals and Policies:

The discussion in Section 5.2.1. in relation to the proposed project is applicable to Alternatives 1 and 2. Improvements to public facilities are are integral to the Kona Kai Ola development. The provision of additional boat slips and numerous road improvements, including a makai extension of Kuakini Highway south to Kailua-Kona are incorporated into plans for the project's development. In light of these elements, Alternatives 1 and 2 are consistent with the goals and policies of this section.

HCGP Section 11 – Public Utility Goals, Policies:

As with the proposed project, Alternatives 1 and 2 are consistent with the goals and policies of this section, based on the relevant grounds set forth in Section 5.2.1. The developer is committed to design, fund, and develop environmentally sensitive and energy efficient utility systems to the extent possible, as described previously in Part 5. Its master planning provides for the coordinated development of such systems with the objective of achieving significant savings for the public. As previously-mentioned example, the project development involves the upgrading of the Kealakehe Wastewater Treatment Plant.

HCGP Section 12 – Recreation:

Alternative 1 is consistent with the goals, policies, and courses of action for North Kona in this section.

Although the number of slips is reduced under Alternative 1, the region's boating opportunities and support facilities will still be expanded. The existing marina entrance would still be utilized under this alternative. However, concerns relating to increased activity leading to increased congestion in the marina entrance area would be mitigated to a certain extent. The 400-600 foot shoreline setback, public parks, trails, cultural areas, community facilities and marine science center remain important components of Alternative 1.

The golf course component of Alternative 2 would add a more passive recreation to the active and social components, such as boating, fishing, swimming, trails, walkways, parks, marine life, educational and interactive areas that are also part of the project. The golf course would enhance the range of leisure and recreational opportunities offered at Kona Kai Ola. Alternative 2 is also considered to be consistent with this section.

HCGP Section 13 and 13.2 – Transportation:

The reduced marina component under Alternative 1 will still provide transportation opportunities and provide for possible use of transit water shuttles to Kailua-Kona, although to a lesser degree than under the proposed project and Alternative 2 . However, in each scenario, internal people-movers are planned, and numerous roadway improvements are planned for coordination with public agencies, including but not limited to the construction of the Kuakini Highway extension between Honokōhau and Kailua-Kona. Accordingly, both Alternatives 1 and 2 are consistent with the goals, policies, and courses of action for North Kona under these sections of the General Plan.

HCGP Section 14.3 – Commercial Development:

For the reasons presented in the discussion under Section 226-104 of the State Plan, the planned commercial component under Alternatives 1 and 2 are consistent with this section.

HCGP Section 14.8 – Open Space:

Alternatives 1 and 2 are consistent with the goals and policies of this section. Alternative 1 provides a considerable (400-600 foot) shoreline setback along the entire ocean frontage of the project site as a means of protecting the area's scenic and open space resources, as well as natural and cultural resources. Although it does not incorporate the shoreline setback planned in Alternative 1, Alternative 2 provides a golf course component would contribute to the amount of open space that is currently proposed and allow additional view corridors to be created.

Community Development Plans

Community development plans are being formulated for different regions in the County in order to supplement the County's General Plan. The Kona Kai Ola project is located in the Kona Community Development Plan (CDP) area. Maps associated with the preliminary work phases

of the Kona CDP include the Kona Kai Ola project site within the "Preferred Urban Growth" boundary of the North Kona district. The Kona CDP process is guided by a Steering Committee composed of a broad cross-section of the community. The Steering Committee will eventually complete its work and recommend the CDP's adoption.

After the DEIS was published, the Kona CDP has progressed to the development of plans for the major urban growth corridor north of Kailua-Kona. The Kona CDP has produced a draft plan showing a transit oriented development that includes a midlevel public transit corridor along the mauka residential elevation, and a makai transit corridor that runs along a proposed new frontage road just makai and parallel to Queen Kaahumanu Highway. The development plan for Alternative 1 includes the Kuakini Highway as part of this proposed frontage road and transit line from Kailua Kona to the Kealakehe area, along with a transit stop at Kona Kai Ola. The Alternative 1 plan also includes a road that could be extended to be part of the proposed frontage road should it be approved and implemented. In addition, the Kona CDP has continued to emphasize the principles of smart growth planning with mixed use urban areas where people can live, work, play and learn in the same region. Kona Kai Ola has been specifically designed to be consistent with this policy in order to provide a stable employment base close to where people live in the mauka residential areas already planned for DHHL and HHFDC lands.

It should be noted that currently and over the years, the 1990 Keāhole to Kailua Development Plan (K-to-K Plan) guides land use actions by the public and private sectors. It is intended to carry out the General Plan goals and policies related to the development of the portion of North Kona area, including the Kona Kai Ola site. The "Preferred Growth Plan" of the Keāhole to Kailua Development Plan identifies the project site as a new regional urban center to include commercial, civic, and financial business related uses, an expanded "Harbor Complex," a shoreline road, and a shoreline park. The proposed project and the development concepts in Alternatives 1 and 2 are therefore consistent with the recommendations in the Keāhole to Kailua Development Plan.

Hawai'i County Zoning

As shown on Figure AA, the project site is zoned "Open". Under Section 25-5-160 of the Hawai'i County Code, "The O (Open) district applies to areas that contribute to the general welfare, the full enjoyment, or the economic well-being of open land type use which has been established, or is proposed. The object of this district is to encourage development around it such as a golf course and park, and to protect investments which have been or shall be made in reliance upon the retention of such open type use, to buffer an otherwise incompatible land use or district, to preserve a valuable scenic vista or an area of special historical significance, or to protect and preserve submerged land, fishing ponds, and lakes (natural or artificial tide lands)".

Some of the proposed uses at Kona Kai Ola are permitted uses in the Open zone such as:

- Heiau, historical areas, structures, and monuments;
- Natural features, phenomena, and vistas as tourist attractions;
- Private recreational uses involving no aboveground structure except dressing rooms and comfort stations;

- Public parks;
- Public uses and structures, as permitted under Section 25-4-11.

In addition to those uses permitted outright, the following uses are permitted after issuance of a use permit:

- Yacht harbors and boating facilities; provided that the use, in its entirety, is compatible with the stated purpose of the O district.
- Uses considered directly accessory to the uses permitted in this section shall also be permitted in the O district.

The proposed time-share and hotel units and commercial uses would not be consistent with the zoning designation of "Open". Project implementation therefore requires rezoning of portions of the project to the appropriate zoning category or use permits for certain uses.

Special Management Area

As shown in Figure AB, the entire project area up to the highway is within the coastal zone management zone known as the Special Management Area ("SMA"). At the County level, implementation of the CZM Program is through the review and administering of the SMA permit regulations. Kona Kai Ola complies with and implements the objectives and policies of the Coastal Zone Management (CZM) Program, and a full discussion is provided in Section 5.1.3. The development concepts in the proposed project and Alternatives 1 and 2 will be subject to applicable SMA rules and regulations.

Envelope Postmarked Feb 7 '07

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawai`i 96850

In Reply Refer To:
2007-FA-0026

FEB -6 2007

Ms. Linda Chin
Department of Hawaiian Homelands
1099 Alakea St., Suite 2000
Honolulu, Hawai`i 96813

Dear Ms. Chin:

The U.S. Fish and Wildlife Service (Service) has reviewed the Draft Environmental Impact Statement (DEIS) provided by your office for the Kona Kai Ola marina expansion, timeshare and resort development at North Kona, Hawai`i. The following comments on the DEIS have been provided for your consideration. Please note that all recommendations in our letter refer to preparation of a revised DEIS. If, however, you decide to prepare a Final EIS, please address these comments in the Final EIS.

The proposed project involves the development of land in North Kona with a 45-acre, 800-slip marina, 1,803 time-share units, a resort with up to 700 hotel units, and other supporting infrastructure. The project area encompasses 530 acres, of which 200 acres are owned by the Department of Hawaiian Homelands and 330 adjacent acres are owned by the Department of Land and Natural Resources (DLNR). Of this acreage, 15.5 acres lie within the legislated boundary of Kaloko-Honokohau National Historical Park (NHP).

It is our understanding, the proposed project will require the applicants obtain a permit from the Army Corps of Engineers for the excavation and opening of marina basin and the removal of anchialine ponds. This permit will be subject to our review under the Clean Water Act and may require consultation under the Endangered Species Act (ESA).

GENERAL COMMENTS

Adequacy and scope

The DEIS explores only a single alternative, that of No Action. While we understand the limits imposed on this project as part of the lease agreement with the State of Hawai`i, we feel that alternatives scales of the project and orientations of the harbor expansion should be explored. Specifically, we recommend an alternative that would include a smaller harbor expansion and/or harbor orientation that would result in less impact to the anchialine ponds south of the existing harbor channel and alleviate boating congestion at the harbor mouth. We also recommend an analysis of an alternative that does not include the proposed artificial lagoon system.

As currently written, the DEIS presents insufficient detail on the proposed project design and documentation of existing biological and physical resources upon which to base an adequate assessment of potential impacts to fish and wildlife, especially federally listed species. The potential impacts associated with numerous unresolved issues, including the source of an additional 2.6 million gallons per day (mgd) of potable water, and impacts resulting from construction of worker housing should be analyzed as part of this project because these activities are part of a single connected project action. The piecemealing of projects that are the result of a single action should be avoided. Proposed mitigation measures for significant impacts identified in the DEIS, such as impacts to anchialine pond resources and sensitive species, are vague and of limited value. We recommend that the descriptions of proposed mitigation measures include enough detail to allow sound conclusions to be made on their adequacy to serve as project mitigation. Coordination with the Service, National Marine Fisheries Service (NMFS), and the DLNR is recommended during development of more detailed mitigation plans.

The DEIS does not fully address potential project-related impacts to Kaloko-Honokohau NHP. Kaloko-Honokohau NHP was recognized by the U.S. Congress as a site of national significance and entrusted to the National Park Service to protect for future generations. The proposed project will result in the destruction of natural and cultural resources within the park's administrative boundary. Harbor outflow, and the pollutants contained therein, will be transported into the waters of Honokohau Bay, which is inside the park's administrative boundary, and could potentially impact federally listed and other trust species that use this area to feed and rest. We recommend that additional actions be taken to preserve the resources of Kaloko-Honokohau NHP and that project alternatives, which preserve the anchialine ponds to the south of the harbor mouth and reduce coastal marine impacts, be considered.

Potential impacts to the aquatic and marine environments

As currently written, the DEIS does not provide adequate information to support the stated conclusions that the proposed project will have no effect on coastal aquatic and marine ecosystems, specifically with regard to federally listed species, including the endangered 'ea or hawksbill sea turtle (*Eretmochelys imbricata*) and threatened honu or green sea turtle (*Chelonia* *mydas*), and the candidate shrimp and damselfly species, *Metabetaeus lohena* and *Megalagrion xanthomelas*, respectively. All four species occur either at the proposed project site or on lands or waters adjacent to the proposed project site. Considerable investment has been made to protect and recover these species, and loss of important feeding and resting areas would be detrimental to the effort. The aquatic and marine assessments conducted in support of this DEIS lack the scientific rigor and key data necessary for supporting sound conclusions.

Potential impacts resulting from increased nutrient and pollutant load from harbor outflow have not been sufficiently characterized and are presented in a misleading manner. While pollutant *concentrations* are expected to decrease in the harbor outflow, the total pollutant *load* is anticipated to increase as a result of enrichment from marine life held in the proposed artificial lagoon system, increased surface runoff from landscaping and roads, and increased marina activities including boat fueling and general maintenance and operations. Increases in nutrient load can result in shifts in coral reef species composition, particularly in benthic organisms. These changes have the potential to negatively impact federally listed species. We recommend that the DEIS contain a clear discussion of pollutant loads and their potential affect on the coastal marine environment. Additionally, we recommend that all potential sources of pollutants that may contaminate the groundwater and harbor be identified and assessed.

Anchialine ponds represent a rare habitat in Hawai`i, containing many endemic species that are candidates for listing under the ESA. The destruction of the 22 anchialine ponds south of the harbor channel represents a significant reduction of this sensitive wetland habitat in the Kona area, especially as it supports the declining Federal candidate damselfly, *M. xanthomelas* and anchialine pond shrimp, *M. lohena*. Creation of human-made ponds into which *M. lohena* have successfully recruited has had limited success, and we recommend that the Service be contacted to review proposed mitigative measures prior to the construction of any artificial pools. Project-related impacts will likely contribute to the further decline of the damselfly and shrimp. We recommend that these rare pond habitats not be destroyed and that project alternatives that do not impact anchialine ponds be considered in the revised DEIS.

In addition, groundwater on and around the proposed project site has been poorly characterized, and the DEIS contains several inconsistencies in the groundwater flow data. It is unclear how groundwater in the lands north of the proposed project area, which feeds numerous significant anchialine ponds, including Aimakapa and Kaloko fishponds, will be impacted by the increase in the harbor basin size. These ponds provide habitat for numerous Federal trust species, including endangered Hawaiian waterbirds such as the ae'o or Hawaiian stilt (*Himantopus mexicanus knudseni*) and the 'alaeke'oke'o or Hawaiian coot (*Fulica alai*). Groundwater flow data suggest that Honokohau Harbor acts as a focusing point for groundwater, but it is unclear what effect harbor expansion will have on the flow of groundwater through this northern anchialine pond system. We recommend that further groundwater data be collected to better describe the groundwater dynamics of this region. Additionally, impacts to groundwater as a result of the withdrawal of an additional 2.6 mgd for potable water have not been clearly described. Uncertainties about the point sources of these withdrawals need to be eliminated before an accurate assessment of potential groundwater impacts can be made. The assessment of groundwater resources should follow recommendations provided in the Office of Environmental Quality Control "Guidelines for Assessing Water Well Development."

Potential take of listed species

As currently described, we believe the proposed project has the potential to result in the take of listed species as described in our specific comments below. As you may be aware, section 9 of the ESA, as amended, prohibits take of any listed animal species. The ESA defines "take" as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. We further define the term "harass" as an intentional or negligent act or omission that creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns, which include, but are not limited to, breeding, feeding, or sheltering. The term "harm" has also been further defined to mean an act that actually injures or kills wildlife. Such acts may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns including breeding, feeding, or sheltering. Exemptions to the prohibition of take are found under section 7 and 10 of the ESA. It is our understanding that this project will require obtaining an Army Corp Permit which will require consultation with us. We recommend that potential impacts to listed species be considered in full, as described in our specific comments, below in a revised DEIS. In addition we recommend the applicant coordinate with DLNR prior to project approval regarding necessity of an incidental take license for impacts to listed species.

SPECIFIC COMMENTS

Introduction and Project Description (page 13): We support the development of "green" infrastructure and commend the project sponsor's commitment to the "...construction and operation of high performance green buildings." We recommend that the DEIS also consider other forms of green infrastructure, including, but not restricted to, semi-permeable surfaces to reduce surface water impacts, and the use of native dry-land (xeric) species for landscaping.

Introduction and Project Description (page 16): The proposed lagoon system could serve as valuable habitat for endangered water birds and protected migratory birds. The features of the lagoon (e.g. depth, plants, etc) would contribute to its attractiveness to these species. It should be made clear in the DEIS whether attracting these species is a goal of the proposed lagoon. Artificial ponds that attract birds have the potential to a become bird population "sinks" unless the ponds are managed appropriately. We recommend that the Service be contacted regarding the proposed lagoon design in order to protect listed and migratory birds and that a lagoon management plan that addresses predator control in the proposed project area, management actions to enhance habitat quality, mitigative actions to alleviate impacts from other lagoon uses on sensitive bird species, and a plan to monitor the sensitive bird populations be assembled.

Examples of plans with these measures are available on the Big Island and elsewhere in the State of Hawai`i.

Alternative Analysis (page 19-20): The DEIS explores only one alternative, that of No Action. While other densities and use mixtures were considered in a market study (Appendix B), they are not summarized in the narrative. No alternatives that explore fewer boat slips or different orientations of the harbor are proposed and explored. We recommend that the information regarding reduced densities and be summarized and that additional alternatives describing alternate orientations and size of the harbor and the exclusion of the artificial lagoon be assessed.

Assessment of Existing Natural Environment (page 34): Much of the flora in the coastal area downstream of the proposed harbor expansion relies on groundwater to survive. It is unclear how project-related interruptions of groundwater flow may impact these species. We recommend that this potential impact be assessed and that the revised DEIS examine an alternative that reduces impacts to groundwater flow to this coastal area.

Assessment of Existing Natural Environment (page 35): We anticipate that the proposed lagoon may attract Hawaiian waterbirds, such as the Hawaiian stilt and the Hawaiian coot, and protected migratory birds. We recommend that the Service be contacted regarding the proposed lagoon design in order to protect migratory birds and that a lagoon management plan that addresses predator control in the proposed project area, management actions to enhance habitat quality, mitigative actions to alleviate impacts from other lagoon uses on sensitive bird species, and a plan to monitor the sensitive bird populations be assembled. See "Introduction and Project Description (page 16)" for additional detail.

Assessment of Existing Natural Environment (page 35): Coastal developments can present a potential hazard for birds protected under the ESA or the Migratory Bird Treaty Act [16 U.S.C. 703-712]. In Hawai`i there are several species of federally listed seabirds that are attracted to lights and are known to collide with buildings, light poles, wires, and other tall objects. The use of shielded exterior lights is commendable, but the DEIS does not contain sufficient detail on the plan for exterior lighting to adequately assess the effectiveness of this proposed mitigative measure. We recommend the proposed mitigation be discussed in greater detail in the revised DEIS.

Assessment of Existing Natural Environment (page 35): During the clearing of vegetation for construction, introduced terrestrial predators, such as mongoose and rats, can be displaced onto adjacent vegetated properties. These displaced predators can increase the impact on native species, particularly native birds. We recommend that predator control be included as a mitigative measure for the life of the project.

Assessment of Existing Natural Environment (page 35): Bird surveyors observed the federally endangered Hawaiian stilt transiting the proposed project area. In 2005, monthly surveys at Kealakehe Wastewater Treatment Plant, Kaloko Pond, and Aimakapa Pond documented a total monthly average of up to 108 adult stilts at these three sites in close proximity to the project area[1]. If shallow pooling of water occurs during construction (e.g. marina, lagoon, temporary water storage facilities, any ground depressions), as has occurred in similar projects, it is likely that Hawaiian stilts will be attracted to such areas to forage and attempt to breed. Construction activities may cause harm to foraging stilts and will likely lead to unsuccessful breeding. Therefore, we recommend that the project include best management practices (BMP) or other measures to minimize shallow pooling of water and measures to avoid and minimize potential harm and unsuccessful breeding attempts by the endangered Hawaiian stilt.

Assessment of Existing Natural Environment (page 44): Little information has been provided on the range of boat maintenance activities that will be allowed at the marina. Boat maintenance facilities, including wash-down facilities and hull refinishing facilities, have the potential to be significant point sources for pollutants. We recommend that the proposed facilities included in the expanded marina be clearly identified and that appropriate mitigative measures be proposed.

Assessment of Existing Natural Environment (page 44-46): The assertion that pumping 75 mgd of seawater into the artificial lagoon system will lower nutrient concentrations in the water flowing out of the harbor basin and have a positive environmental impact is not supported by the data. While it is correct to anticipate that nutrient *concentrations* will decrease, the total *load* of nutrients and pollutants into coastal marine waters will likely increase as a result of this project. Nutrient concentrations are usually expressed in mass/volume units, and increasing the volume will lower the concentration without changing the total load (e.g., mass) of the nutrient or pollutant present. Total load into a system is biologically important, especially in semi-enclosed systems such as Honokohau Bay. The prevailing currents at the proposed project site are anticipated to transport the harbor flow and its pollutants north into Honokohau Bay, which has extensive coral reef and is an important feeding and resting ground for hawksbill and green sea turtles. If no additional inputs were to be added to the harbor flow, the total nutrient load would remain constant. However, additions of nutrients from the animals to be held in the proposed artificial lagoon and pollutants from the expanded harbor activity and infrastructure are anticipated to cause an increase in nutrient and pollutant load in the harbor flow. Human-caused nutrient increases degrade nearshore marine and aquatic environments by creating poor water quality conditions that result in detrimental impacts to coral reef community structure. Increased nutrient input can promote the growth of algae, including invasive alien species that are destructive to the native coral reef ecosystem. Finally, nutrient uptake by coral reef organisms is correlated with water velocity over the bottom[2]. Higher water velocities increase the uptake rate of nitrogen and phosphorous by coral reef animals by thinning the water boundary layer near the bottom. This would cause nutrient impacts to occur at lower water concentrations. We recommend that the DEIS contain a clear discussion of pollutant loads and their potential affects

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[1] Waddington, J. S. 2005. Kona coast waterbird and shorebird surveys (Sept. 2004 - Aug. 2005). Prepared for Ducks Unlimited, Inc. 19 pp.

[2] Bilger, R. W. and M. J. Atkinson. 1995. Effects of nutrient loading on mass-transfer rates to a coral-reef community. Limnol. Oceanogr. 40(2): 1995,279-89.

on the coastal marine environment and federally list species. We also recommend that the applicant coordinate with the National Marine Fisheries Service, the lead agency for federally listed sea turtles in the water.

Assessment of Existing Natural Environment (page 46): Boat hulls and ballast water are significant potential sources of invasive sessile marine species, including mollusks, algae, sponges, and tunicates. Provisions to reduce the threat of species introductions should be identified and discussed.

Assessment of Existing Natural Environment (page 48): Surveys of the anchialine pond fauna appear to be incomplete. Survey results included only two anchialine pond crustaceans, *Halocaridina rubra* (a species of concern) and *M. lohena* (candidate species), a single snail species, and an introduced minnow. It is unlikely that this represents the biotic diversity of these ponds. Surveyors of the anchialine ponds in Kaloko-Honokohau NHP, which include several of the ponds in the proposed project site, found the anchialine snail (*Neritilia hawaiiensis*), orange back damselfly (*M. xanthomelas*), and other shrimp including *Palaemonella burnsi* (candidate species)[3]. Survey methods described in the DEIS were limited in scope and effort (22 ponds surveyed in one day) and the methodologies did not sample for non-aquatic anchialine pond species, such as *M. xanthomelas*. We recommend conducting additional surveys in order to have a more complete biological inventory of the ponds including a sampling methodology for *M. xanthomelas* and all other damselfly species.

Assessment of Existing Natural Environment (page 51): The proposal to restore existing anchialine ponds in Kaloko-Honokohau NHP and to create additional artificial pools as mitigation for destroying 22 anchialine ponds appears to be problematic. We recommend that additional detail be included in the revised DEIS. Implementation of restorative actions on ponds in Kaloko-Honokohau NHP is contradictory to the data presented in the study, which suggests these ponds are already in good shape. In addition, attempted establishment of *M. lohena* in artificial ponds has had limited success at other locations. Transplanting *H. rubra* has proven successful, but is not without its complexities. Recent genetic work has found distinct lineages within the Hawai`i population of *H. rubra*[4]. These lineages would be important if these shrimp are to be transplanted to another pond, and we recommend that the Service be consulted when developing mitigation plans for this species.

Assessment of Existing Natural Environment (page 52): The data presented does not support a finding of no significant impact to the blue marlin fishery. It is unclear how many new boats added to the Kona fleet as a result of the expanded marina will engage in marlin fishing

[3] DeVerse, K. 2005. Appendix A: Kaloko-Honokohau National Historical Park Resource Overview. In "Pacific Island Network vital signs monitoring plan" by HaySmith, L., F. L. Klasner, S. H. Stephens, and G. H. Dicus. Natural Resource Report NPS/PACN/NRR—2006/003. National Park Service, Fort Collins, Colorado.

[4] Santos, S. R. 2006. Patterns of genetic connectivity among anchialine habitats: a case study of the endemic Hawaiian shrimp *Halocaridina rubra* on the island of Hawaii. Mol. Ecol.

activities. Currently, 68percent of the Kona fleet engages in fishing and accounts for 30percent of the statewide angler catch (Appendix Q). Under this current fishing pressure, the fishery has seen a decrease in catch per unit effort (CPUE) and average size since 1980. Appendix Q, Marine Fisheries Study, further notes "[an] increase in the number of fishing vessels is likely to cause a decrease in number and size of fish captured per trip and have a disproportionate impact on larger females which are responsible for most of the reproductive capacity of the fishery," which contradicts the no significant impact statement in the DEIS narrative. We recommend that the DEIS narrative provide the data used to determine no significant impact or change the narrative to reflect the data presented in Appendix Q.

Assessment of Existing Natural Environment (page 53): We recommend that the DEIS explore mitigative measures that will limit the number of slips available for charter and commercial fishery activities. Base on stakeholder interviews in Appendix Q, Marine Fisheries Study, a limit on the number of the charter fishery slips in the harbor expansion would be received favorably by stakeholders.

Assessment of Existing Natural Environment (page 57): Numerous studies examining the potential impact of noise on marine species have been overlooked. Studies have demonstrated avoidance behavior in fish when exposed to noise in the same frequency range and intensity as that produced by small boat engines[5, 6]. Other studies have demonstrated links between underwater noise and fish egg viability, fry growth and hearing, and shrimp growth, mortality, and reproductive rates. We recommend that these studies be incorporated in the assessment of underwater noise to supply a more accurate discussion of the issue.

Assessment of Existing Natural Environment (page 59): The location of the injection well has not been identified for the Seawater Air Conditioning (SWAC) effluent. If injection wells are to be used for circulated-water disposal, we recommend that the DEIS include a quantitative analysis of the effects of the injection on ground-water flow and quality.

Assessment of Existing Natural Environment (page 80): The DEIS has not adequately addressed the presence of anchialine ponds and associated Federal trust species within the administrative boundary of Koloko-Honokohau NHP. The park protects over 10percent of the anchialine ponds found on the island of Hawai`i and contains habitat used by several federally candidate and listed species. The proposed project area contains natural resources that are within the administrative boundary of the park that will be lost as a result of this proposed development. Park resources outside the proposed project area may also be at risk if groundwater resources are negatively impacted[7]. Assessments for the proposed project suggest that groundwater from the park is

[5] Scholik, A.R. and H. Y. Yan. 2001. Effects of underwater noise on auditory sensitivity of a cyprinid fish. Hearing Research 152: 17-24

[6] Mitso, R. B. and H. P. Knudsen. 2003. Causes and effects of underwater noise on fish abundance estimation. Aquatic Living Resources 16: 255–63

[7] HaySmith, L., F. L. Klasner, S. H. Stephens, and G. H. Dicus. 2005. Pacific Island Network vital signs monitoring plan. Natural Resource Report NPS/PACN/NRR—2006/003. National Park Service, Fort Collins, Colorado.

currently drawn into the existing Honokohau Harbor. The effect of increasing the size of the harbor and potentially drawing more water out of the park has not been addressed. We recommend that additional groundwater data be collected to clarify the amount currently drawn away from the Kaloko-Honokohau NHP and for inclusion in an improved assessment of the potential impact of increasing the harbor basin size.

Assessment of Existing Natural Environment (page 96): Expansion of the marina is expected to increase the number of SCUBA diving charters. Addition of moorings at popular diving locations will alleviate anchor damage, but will also allow more boats to visit dive sites. Divers can have a significant impact on popular dive sites when diver density is high. We recommend the DEIS assess the potential impact of increased diver density on the coral reef ecosystem.

Assessment of Existing Natural Environment (page 99): It is proposed that impacts resulting from the construction of worker houses be detailed in a separate site-specific EIS. However, construction of worker housing is required as an action connected to the Kona Kai Ola project and should be evaluated as part of the proposed project in a single document. These projects should not be "piecemealed," and we recommend that analysis of the proposed project include in the impacts associated with worker housing construction in the revised DEIS.

Assessment of Existing Natural Environment (page 103): The DEIS proposes to mitigate anticipated project related increases in solid waste through an intensive recycling effort. It is unclear how this program will achieve a 90percent reduction rate. The national recycling average is just over 30percent and a 50percent reduction by the state of the California in 2006 has been described as a "historic achievement."[8] In light of the current recycling infrastructure available in Kona, a 90percent reduction appears unrealistic. We recommend more detail be provided on the proposed recycling program so decision-makers can better assess the effectiveness of this proposed mitigative measure.

Assessment of Existing Natural Environment (page 104): Neither the impacts of withdrawing 2.6 mgd from the Kona groundwater system nor the source of this proposed withdrawal have been identified. While water will come from the municipal water system, additional wells need to be added to meet the demands of the proposed project. Groundwater along Kona is important to Federal trust species, particularly those in coastal ecosystems, such as anchialine ponds. Submarine groundwater discharges are important features in the coastal marine waters of Kona and alterations in the groundwater discharge rate will impact coastal coral reefs. Potential impacts of the groundwater withdrawal to meet the potable water demands associated with the proposed project should be included in this DEIS, as they represent a single course of action. We recommend that the source of groundwater withdrawal be determined and that potential impacts from the 2.6 mgd withdrawal be examined.

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[8] Letter from Margo Brown, Chair, California Integrated Waste Management Board

Assessment of Existing Natural Environment (page 106-108): We recommend that the DEIS contain a clear discussion of pollutant loads and their potential affect on the coastal marine environment. See "Assessment of Existing Natural Environment (page 44-46)" for additional comments on nutrient and pollutant *concentration* versus *load.*

Conformance with Public Plans and Policy (page 119): We recommend that the DEIS clearly state that all 22 anchialine ponds south of the harbor mouth will be destroyed as a result of this project. As written, the DEIS is unclear, stating that "...Kona Kai Ola project will result in the destruction of some of these [anchialine ponds], and change from brackish water to seawater ecosystems for other ponds...." Conversion of the anchialine ponds from brackish water to seawater will result in destruction of the native anchialine pond organisms, including the candidate species *M. lohena* and *M. xanthomelas*, known to occur within them.

Conformance with Public Plans and Policy (page 141): We recommend the DEIS assess the potential impact of increased diver density on the coral reef ecosystem. See "Assessment of Existing Natural Environment (page 96)" for comments on diver impacts.

Probably Adverse Impacts (page 159): We recommend that the DEIS clearly state that the 22 anchialine ponds south of the harbor mouth will be destroyed as a result of this project. See "Conformance with Public Plans and Policy (page 119)" for comments regarding the current wording contained in the DEIS.

Appendix G: Analysis of Variance (ANOVA) was used to detect statistically significant differences among survey sites. We recommend that all discussions of the statistical methods in this Appendix state the power of the analysis to detect significant differences.

Appendix G: A reduced ANOVA model, or one lacking an interaction term between the factors, has been used in all analyses. Disregard for a potentially significant interaction among the model factors can lead to erroneous conclusions. We recommend that all data be reanalyzed using the full model ANOVA.

Appendix G: We recommend that all tables reporting mean values also include a measure of the variation about the mean (e.g., standard deviation, standard error of the mean, etc.)

Appendix G: Figure 2 shows transect B adjacent to Aimakapa Pond, yet the text states transect A is adjacent to the pond. We recommend clarification of which transect is located adjacent to Aimakapa pond.

Appendix G: We recommend implementation of additional anchialine pond surveys with methodologies capable of sampling for *M. xanthomelas* and other damselfly species. See "Assessment of Existing Natural Environment (page 48)" for comments on the sampling methods and efforts used to conduct anchialine pond inventories.

Appendix G: The groundwater flow diagram in Figure 10 contradicts the flow diagrams elsewhere in the DEIS. We recommend that the groundwater flow diagrams and discussions be made consistent throughout the document.

Appendix G: The differences found among depths for fish count data could be the result of a sampling artifact; the methodology used to count fish does not sample equally at all depths. All fish within a 4 by 25 meter area to the water's surface were counted. With increasing depth, a greater volume was sampled and one would expect a greater number of individuals to be found. Increased numbers of individuals would result in a higher species diversity and greater biomass. Unless the sample is standardized, the survey data cannot be compared and the results are not easily interpreted. We recommend that data be standardized appropriately and reanalyzed.

Appendix G: The potential impacts of the harbor outflow have not been fully examined. The harbor outflow will contain increased nutrient loads (not to be confused with nutrient concentrations) that will be transported by coastal currents into Honakohau Bay, which is an important feeding and resting site for endangered sea turtles. Nutrient enrichment can have an adverse impact on coastal coral reefs, causing changes in species composition, and may adversely impact food species for both hawksbill and green sea turtles. We recommend that the potential impact of increased nutrient and pollutant loads on these federally listed species be examined.

Appendix Q: No scientific basis has been provided for the assumption that 160 dB of noise will cause no impact to marine species. Scientific studies have demonstrated that noise below 160 dB can have adverse impacts on marine life[9]. We recommend that the threshold is lowered to reflect the current scientific understanding of noise impacts on marine life or that scientific justification is provided for the 160 dB threshold.

Appendix Q: The discussion omits numerous studies that presents opposing data on the adverse impacts of underwater noise to marine life[10, 11]. We recommend that these studies be incorporated into the assessment of underwater noise to supply a more accurate discussion of the issue.

Appendix Q: Green sea turtles are not on the threatened species list "...due to their resemblance to hawksbill turtles...." The green sea turtle was listed as threatened because of extreme declines in the population over the past 30 years. We recommend the author consult the recovery plan for the green sea turtle[12] to obtain accurate information on the threats to and the reasons for the listing of this species.

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[9] Scholik, A.R. and H. Y. Yan. 2001. Effects of underwater noise on auditory sensitivity of a cyprinid fish. Hearing Research 152: 17-24

[10] Myrberg, A. 1980. Fish bio-acoustics: its relevance to the "not so silent world" Environ. Biol. Fish. 5: 297-304.

[11] Mitso, R. B. and H. P. Knudsen. 2003. Causes and effects of underwater noise on fish abundance estimation. Aquatic Living Resources 16: 255–63

[12] National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1998. Recovery Plan for U.S. Pacific Populations of the East Pacific Green Turtle (*Chelonia mydas*). NMFS, Silver Spring, MD.

Appendix Q: Small boat engines produce sound within the range of turtle hearing. The anecdotal observation that a "…turtle will only startle and evade after it lifts its head free of the water and sees the approaching boat…" is insufficient evidence to support the conclusion that turtles are not impacted by marine noise. Turtles are most easily observed by boaters only after moving. It is unknown how many turtles are "startled" by boats or anything else without lifting their head. Without supporting data on the head lift/startle response, we recommend removing the anecdotal statement.

SUMMARY COMMENTS

To serve as a decision document, we recommend that the DEIS be strengthened. As currently written, the DEIS lacks sufficient details on the proposed project design to adequately address potential impacts to fish and wildlife, especially federally listed species. The assessment of current environmental conditions, the analysis of potential impacts and the proposed mitigation measures are not fully developed and at times are contradictory, especially with regard to aquatic and marine resources. In particular, the assessment of groundwater resources should be improved, following recommendations provided in the Office of Environmental Quality Control "Guidelines for Assessing Water Well Development."

The impacts associated with potable water withdrawal and construction of worker housing should be included as part of the analysis of this project since they represent integral components of a single proposed project. The piecemealing of projects that are the result of single action should be avoided.

Currently, the proposed mitigation measures lack necessary detail to determine their beneficial impact to natural resources. In some cases, particularly regarding the impacts to anchialine pond resources, the proposed mitigations may be ineffective. Coordination with the Service, NMFS, and the Hawai`i DLNR is recommended during development of more detailed mitigation plans. If the Army Corps of Engineers determine that the proposed project may affect listed species, then consultation under the ESA would be required prior to project implementation.

We appreciate the opportunity to provide comments on the DEIS for the proposed project. We hope our comments are useful in improving the DEIS and look forward to reviewing a revised document when it is available. If you have questions regarding this letter, please contact Fish and Wildlife Biologists Dwayne Minton (808/972-9445), Peter Cohen (808/972-9409), or Lorena Wada (808/972-9463).

Sincerely,

for Patrick Leonard
Field Supervisor

cc: Ms. Genevieve Salmonson, OEQC
Dr. Dayan Vithanage, Oceanit
Mr. Scott Condra, Jacoby Development, Inc.
Mr. Christopher Yuen, Hawai`i County Planning Department
Dr. Dan Polhemus, DLNR
Mr. Paul Conry, DOFAW
Mr. Dennis Lau, CWB
Ms. Laura Thielen, CZMP

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July 23, 2007

Patrick Leonard, Field Supervisor
U.S. Department of the Interior
Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
300 Ala Moana Blvd., Rm. 3-122, Box 50088
Honolulu, Hawai‘i 96850

Dear Mr. Leonard:

Subject: Kona Kai Ola Draft Environmental Impact Statement
Response to Your Comments Dated February 6, 2007

Thank you for your comments on the Kona Kai Ola Draft Environmental Impact Statement. We respond to your comments in the order of page and paragraph. Paragraph numbers on a page start at the first full paragraph.

Page 1, Paragraph 3

We acknowledge your comment regarding your review under the Clean Water Act in the Army Corps of Engineers (ACOE) permit, and have expanded Section 5.3, Permits for Project with the following table:

Agency	Permit or Approval	Requirement	Time Frame
U.S. Army Corps of Engineers	Department of the Army (DOA) Individual Permit	Work in navigable waters; placing fill in waters of the U.S., placing navigation aids Will incorporate: Rivers and Harbors Act Section 10 Clean Water Act Sections 401 and 404 Coastal Zone Management Act Section 307 Endangered Species Act Section 7 National Historic Preservation Act Section 106	Prior to any in-water work or fill or placement of navigation aids or modification of terrestrial habitat that may impact species listed under Endangered Species Act
U.S. Coast Guard	Private Aids to Navigation approval	For approval for marking aids to navigation	Prior to placement. Note: placement requires DOA Permit.
State Board of Land and Natural Resources	Easement over Submerged Lands / Shared Harbor Channel Entrance	HRS Section 171-53 (6)	Prior to commencement of operations of new marina
State Department of Business, Economic Development & Tourism	Determination of Hotel Development	HRS Section 171-42	Prior to approval of Master Development Plan
State Department of Land and Natural Resources (DLNR) Office of Conservation and Coastal Lands (OCCL)	Conservation District Use Permit (CDUP)	For any work in the conservation district Kuakini Highway extension and SWAC pipe; Shoreline Park Hawaiian Cultural Park, Ocean Front Trail	Prior to any work in the conservation district
DLNR Commission on Water Resource Management	Well Construction Permit, Pump Installation Permit	For well construction or ground water source development	Prior to construction or development
State Department of Health (DOH) Clean Water Branch	401 Water Quality Certification	Triggered by DOA permit	Start simultaneously with DOA permit
	NPDES		
	- Indivi dual Permit	Discharge into state waters	Prior to construction
	- NOI Appendix C	Construction activities on one or more acres	Prior to construction
	- NOI Appendix G	Construction dewatering	Prior to construction
	- NOI Appendix L	Discharge of circulation water from decorative ponds	Prior to construction

Agency	Permit or Approval	Requirement	Time Frame
	All NPDES applications	Copy to DLNR/State Historic Preservation Division	Simultaneously with DOH NPDES submittals
	Zone of Mixing	Include with NPDES for discharge into state waters	Concurrent with NPDES application
DOH Safe Drinking Water Branch	Water Source Approval and capacity demonstration	For new drinking water sources	After source is identified
	Operator Certification	For operators of water systems	Before system use
	Construction Plan Review	For water system improvements and connections	Before construction
	Underground Injection Control (UIC) Permit	For injection well operations	Before operations
DOH Clean Air Branch	Dust control management plan	Recommended only, not required	During construction planning
DOH Noise, Radiation, & Indoor Air Quality Branch	No permit	Comply with Administrative Rules Chapter 11-46, Community Noise Control	During construction
County of Hawai'i	Special Management Area (SMA) Major Permit	Work in the SMA	Prior to any construction or other work in the SMA (does not include DHHL land)
	Zoning	Must be consistent with the General Plan	After acceptance of EIS
	Building Permit	To erect a new structure including fences, swimming pools and retaining walls more than 3'-0" in height, and water catchments regardless of depth or capacity	Prior to construction
	Grading, Grubbing, and Stockpiling Permits	For volumes as specified by county	Prior to activity
	Development, subdivision, drainage and flood zone reviews	For development	Prior to construction

Page 2, Paragraph 1

As explained in the DEIS, the agreement between JDI and the State of Hawai'i established a required scope and scale of the project for which the impact analysis was required and is being provided. Several comments have addressed the fact that alternatives other than the No-Project Alternative were not addressed in the DEIS Section 2, Alternatives Analysis.

We are of the position that alternative actions other than a No-Project alternative are not currently feasible without an amendment to the agreement with the State. Agency and public comments in response to the DEIS, as well as additional information generated as a result of inquiry into issues raised by the comments, have been helpful in identifying alternative actions that will serve the State's goal of providing additional marina slips for the Kona area. These alternative actions also serve to reduce or mitigate anticipated effects of the proposed development.

Thus, agencies such as the Land Division of the Department of Land and Natural Resources, the U.S. Department of the Interior Fish and Wildlife Service, the Planning Department of the County of Hawai'i, and the Office of Environmental Quality Control (OEQC), as well as community organizations have commented that a reduced scale marina and related facilities should be considered. The OEQC has also asked that the alternative of a reduced scale project be evaluated under the assumption that DHHL may determine that a downsized project would be preferred.

In response to these comments on the DEIS, and in consideration of measures to mitigate anticipated impacts, the EIS Section 2, Alternatives Analysis, has been revised to describe the following alternatives, which are discussed in more detail in the EIS:

- Alternative 1 is a project involving a 400-slip marina, 400 hotel units, 1,100 time-share units, and commercial and support facilities. This alternative would enhance water quality, avoid the need to widen the existing harbor entrance channel, as well as reduce traffic and socioeconomic impacts.

- Alternative 2 is an alternative that had been previously discussed, but not included in the proposed project that includes an 800-slip harbor and a golf course.

- Alternative 3 is the no-action alternative.

A comparison between impacts related to the proposed project concept and impacts related to Alternative 1 indicates that a reduction in the acreage and number of slips in the marina, as well as the reduction in hotel and time-share units, would generate less environmental, traffic, social, and economic impacts. Although positive economic impacts would be reduced, Alternative 1 can be considered as a preferable alternative because of reduced environmental impacts. However, while it can be concluded that the 25-acre marina in Alternative 1 would be the preferred size, the DLNR agreement establishes the size of the marina at 45 acres and 800 slips. An amendment to the DLNR agreement is required in order to allow Alternative 1 to proceed. Hence, selection of Alternative 1 is an unresolved issue at this time. The additional EIS text that includes the added EIS Section 2, Alternative Analysis, is contained in Attachment 1 of this letter.

Regarding harbor-related alternatives, Moffatt & Nichol (M&N) study has considered alternatives to the conceptual Master Plan based on a smaller harbor size. The M&N study does not include the artificial lagoon system into the developed numerical model, only has considered for some alternatives the inflow of water originated from the lagoons, as a source into the model. (Chapter 5 Appendix U of the EIS).

Alternative 2 does not include the proposed artificial lagoon system.

Page 2, Paragraph 2

We acknowledge your comment regarding the level of detail presented in the EIS. In response to DEIS comments, several additional studies were conducted to expand our understanding of existing conditions, and identify project impacts and proposed appropriate mitigation measures. Additional studies conducted in response to DEIS comments included:

- An Inventory and Assessment of Anchialine Pools Including Management and Mitigation Recommendations
- Marina Harbor Water Quality Study
- Evidence and Implications of Saline Cold Groundwater
- Groundwater Effects on Anchialine Pools
- Supplemental Groundwater Sampling and Analyses for Priority Pollutants
- Description of Marine Mammal and Sea Turtle Species
- Acoustic Analysis of Potential Impacts (related to construction-generated underwater acoustics)
- Ambient Noise Measurements and Estimation Study
- Workforce Housing Impacts Assessment

As the project progresses, more detail regarding potable water sources, worker housing, anchialine pools and sensitive species will be available. The developer will coordinate mitigation plans with the agencies you list, as well as those to whom permit applications will be submitted.

Page 2, Paragraph 3

Kona Kai Ola is being designed to be a mixed urban land use with features and components that enhance the project's compatibility with the Kaloko-Honokohau National Historical Park. There are two locations where the project site is adjacent to the lands designated as part of the Kaloko-Honokohau National Historical Park. One location is between the DLNR property and the park property at Queen Kaahumanu Highway and extending west for 1000'. The other area is on the western boundary of the project site, where 15 acres of the project site are within the legislative designated boundaries of the Kaloko-Honokohau National Historical Park. This is in the area south of the harbor entrance channel, and includes areas of heiau, anchialine pools, 'Alula beach, and other significant cultural and natural resources.

The boundary shared by the northern boundary of the DLNR parcel and the southern boundary of Kaloko-Honokohau National Historical Park is the closest the project gets to the National Park owned land. The rest of the southern boundary of the

Kaloko-Honokohau National Historical Park is shared with DLNR DOBOR land of the Honokohau Small Boat Harbor. The property line between the National Park and Kona Kai Ola runs perpendicular to Queen Ka'ahumanu Highway extending 1000' in from the highway right of way.

Plans for this area in the initial proposed development plan were for "Community Use." JDI received direction from DLNR, the land owner, on their preference for having different land uses in this area. JDI also received input from the community on their preference of a different location for the community area.

Consequently, the proposed use in this area was changed in Alternative 1 to commercial, and marina industrial. A buffer of some distance from the property boundary would be beneficial to both property owners. The planting of screening along the boundary could be considered, especially if it is done with either native plants or Polynesian introductions.

Since the proposed frontage road is included in the Kona Community Development Plan as part of the regional Transit Oriented Development Plan, Kona Kai Ola is seeking to be consistent with this County-initiated plan. Hence, Alternative 1 includes a transit stop at Kona Kai Ola, and a road that could be extended in the future to be the proposed frontage road. Since the Kaloko-Honokohau National Historical Park has not approved this frontage road, the plan does not show the road entering park property, but rather terminating in a cul-de-sac on the DLNR property.

Protection of these cultural and natural resources is a high priority for Kona Kai Ola. Initial steps taken by Jacoby Development, Inc. (JDI) was to modify the initial conceptual master development plan which had a 40' setback from the shoreline, and move the developed area back over 400' from the shoreline to protect the 15 acres of National Park designated lands. The additional studies done in direct response to your comments on the anchialine pools has provided us with the information on how we will be able to restore these anchialine pools, monitor and manage the pools, and ensure that a brackishwater anchialine ecosystem thrives that is healthy to the opae ula and other flora.

This includes mitigation measures to adjust salinity of the pools if they experience salinity levels unhealthy to opae ula and other fauna. JDI also intends to encourage the cultural practice in the community of cultivating opae ula, gathering it, and feeding the fishing ko`a located in the nearshore waters. In addition, JDI has also included mitigation plans to expand opae ula habitat through the creation of new anchialine pools on the project site.

Any work that would be done in the area within your legislative boundaries would be done in close consultation with all the necessary regulatory bodies, and include the Kaloko-Honokohau National Historical Park and the Advisory Council on Historic Preservation.

Page 2, Paragraph 4

In response to DEIS comments, Marine Acoustics, Inc., conducted three studies to evaluate project impacts on marine mammals and sea turtles, including:

- Description of Marine Mammal and Sea Turtles

- Ambient Noise Measurements and Estimation Study
- Acoustic Analysis of Potential Impacts

Findings of these studies will be discussed, as appropriate, to your comments.

Page 3, Paragraph 1

The classification designations for the waters in and surrounding Honokohau Harbor are based on nutrient concentrations. The additional loads to the system are primarily a result of the additional groundwater that is intercepted, and the nutrients contained within that water. Additional loads are only added from the artificial lagoon system.

Alternatives assessing the impacts associated with that lagoon system are presented in Chapter 5 of Appendix U, Harbor Water Quality Modeling Study. However, the proposed expansion attempts to mitigate additional loads as well as eliminate existing loads as much as possible.

- The current WWTP will be upgraded to teritiary treatment with the subsequent highly treated effluent spread upland of the site. This will likely reduce loadings within the groundwater surrounding the proposed site, minimizing the nutrients entering Kona Kai Ola Marina through that pathway (Appendix C of Appendix U).
- The waste facilities surrounding the existing Honokohau Harbor that are currently on-site treated septic tanks that leach into the surrounding ground and likely eventually leach into Honokohau Harbor itself, will be rerouted to the newly upgraded WWTP. This is likely to decrease a significant loading to the system as was described in the data analysis shown in Chapter 1 of Appendix U.
- The possibility of eliminating the artificial lagoon system was considered and analyzed in Chapter 5 of Appendix U.
- Loads from increased marina activities were not considered within the context of the numerical model, as they are assumed to be mitigated with Best Management Practices.
- An intensive non-point source management program is essential to maintaining water quality within the new system which is highly phosphorous limited. These sources include but are not limited to
  - Landscaping (fertilizers),
  - Detergents from household and development use, and
  - Other items.

Page 3, Paragraphs 2 and 3

The DEIS presented information stating that harbor construction would cause an increase in salinity in the anchialine pools makai of the proposed marina basin to become equivalent to the ocean at 35 parts per thousand (ppt) and that the anchialine biology would then perish.

In response to DEIS comments and to further study the pools south of the entrance channel of Honokohau Harbor, a second study was conducted by David Chai of Aquatic Research Management and Design in June 2007. The second survey focused on intensive diurnal and nocturnal biological surveys and limited water quality analysis of the southern group of anchialine pools exclusively. The report is contained in Appendix H-2 of the EIS and is summarized in EIS Sections 3.9.2.1 and 3.9.2.2. In addition, further comment on the groundwater hydrology effects on anchialine pools was prepared by Waimea Water Services and is contained in Appendix G-3 of the EIS.

The DEIS identified 22 anchialine pools. Further studies determined that three of these pools are actually part of an estuary complex with direct connection to the ocean. Of the 19 anchialine pools, six were considered high tide pools (exposed only at medium or high tide), seven were considered pool complexes (individual pools at low tide and interconnected at high tide), and six were single isolated pools. Of the 19 anchialine pools, three pools with a combined surface area of $20m^2$ would be eliminated due to the harbor construction.

While the second survey confirmed the presence of direct human use and disturbance, such as trash receptacles and toilet facilities, it found that the greatest degradation to the majority of the anchialine and estuarine resources was due to the presence of alien fish, including topminnows and tilapia, and introduced plants, predominantly pickelweed and mangrove.

The additional studies indicate that the remaining pools may not increase in salinity to levels unhealthy for *H. rubra* and *M. lohena* and other anchialine pool fauna. Waimea Water Services found that harbor construction would cut off some of the fresher ground-water flow. However, predicting the extent of change in flow is difficult if not impossible even with numerous boreholes and intense sampling. The tides alone create a mixing system that increases salinity, as the flow approaches the point of discharge which will be either the channel or the shore. Another factor that could influence groundwater quality is the increased local recharge from irrigation between the channel and shore. This will add fresh water to the lens locally but is not quantified at this time.

Quantification of these impacts, including the flow of groundwater through each pond, is extremely difficult. The shallow lavas are of the pahoehoe type and have a relatively high horizontal permeability. In surface depressions or undulations, the pahoehoe lavas have a tendency to lose vertical permeability from sedimentation, thus restricting water exchange within the individual pools. This is normally reflected in both the salinity and temperature and this information has been adequately studied in the pools.

Hence, the additional studies found that changes in groundwater quality may or may not impact biological communities in the anchialine and estuarine environment. In either case, the developer is committed to practicing good stewardship over the pools to be preserved and eliminating or reducing alien species to the extent practicable. The developer recognizes it is important to understand these relationships to effectively manage the resource. If there is significant deviation from the baseline, especially in regard to nutrients, pathogens, and toxins, a mitigation plan to determine the cause and take decisive appropriate action will be implemented.

Mitigation measures to facilitate the long-term health of the remaining anchialine pools will be based on environmental monitoring, which is vital as an early warning system to detect potential environmental degradation. A series of quantitative baseline analysis of the physio-chemical and biological components within the project site will provide a standard by which the effects of the development, anthropogenic activities, and natural phenomena on the environment can be measured.

The framework for the mitigation plan will include three measures intended to meet these objectives, including bioretention, salinity adjustment and possible new pools.

Bioretention, which is a Best Management Practice (BMP), is a feasible application for the proposed development. There is a probability that nutrients and other potential pollutants will runoff landscaping and impermeable surfaces such as roadways and parking lots during medium or high rainfall events. Some of these pollutants could enter the groundwater table and into anchialine pools and ultimately the ocean. As an alternative to directing runoff into the ground through drywells, storm water may be directed into bioretention areas, such as constructed surface or subsurface wetlands, vegetated filter strips, grass swales, and planted buffer areas. Storm water held and moved through these living filter systems are essentially stripped of most potential pollutants, and allowed to slowly infiltrate back to the groundwater table.

Another mitigation measure that would be included in the management plan is salinity adjustment. In the 2006 assessment regarding the impact to the southern pools from the proposed construction of the harbor, it was stated that this construction would cause the salinity in the anchialine pools to become equivalent to the ocean at 35 ppt. It was then concluded that the anchialine biology would perish.

There is currently a level of uncertainty by professional hydrologists as to the exact movement of surface groundwater and final determination of anchialine salinity following the harbor construction. The assessment that all anchialine pools will be barren with the construction of the harbor may be premature. *Halocaridina rubra* (opae ula) are routinely drawn from high salinity wells at 30-32 ppt. If the pools do become full strength seawater at 35 ppt, there exists uncertainty on the long-term effects to anchialine organisms, since there are no long-term studies or examples of native anchialine ecosystems at 35 ppt. Native anchialine pool vegetation also has relatively high salinity tolerance.

If the salinity were expected to rise to 35 ppt, possible mitigation in the management plan will include methods to surcharge man-made anchialine pools created adjacent to or in the vicinity of natural pools with low salinity well water. If sufficient volume is used, it is theoretically possible to lower salinity in adjacent natural anchialine pools. This surcharge method has been successfully used to raise salinity in anchialine pools in West Hawaii and cause the salinity rise in adjacent pools of at least up to 10 meters away. Surcharging with low salinity should work as well or better since the lower density water will essentially float atop the higher salinity water at the surface layer, and move throughout the complex of natural pools. Surcharging may also be a viable mitigation to dilute and more rapidly disperse any pollutants that may be detected in the pools.

Another mitigation measure includes the creation of new anchialine pools. There is significant opportunity to create new anchialine pools and greatly expand the native habitat and resource. It has been demonstrated at several projects in West Hawai‘i that anchialine pools can be created and will be colonized with a full compliment of anchialine species endemic to the area. Anchialine pools are considered focal points of higher productivity relative to the subterranean groundwater habitat around them. Their productivity promotes an increase in population levels of anchialine species within the pools themselves and throughout the subterranean habitat surrounding them.

As you suggest, recommendations contained in “Guidelines for Assessing Water Well Development,” as issued by the Office of Environmental Quality Control, will be used in the assessment of groundwater resources.

Page 4, Paragraph 1

The project will comply with requirements under Section 7 for those species that are listed as threatened, endangered or are currently proposed for listing. While candidate species will be discussed in future environmental documents, they will not be part of Section 7 consultations.

The developer will consult with both the USFWS and the State Department of Fish and Wildlife (DOFAW) regarding potential impacts to listed species protected under federal and State of Hawaii endangered species statutes. The consultation with the USFWS will be under Section 7 of the endangered species act, of 1973, as amended, due to the need for ACOE permits. Consultation with the state will be under HRS 195D. The development will comply with all terms and special conditions resulting from those consultations”

Page 4, Paragraph 2

BMPs will be implemented so that the project site will retain runoff from a 2-year 24-hour storm. Low points will be created at roadway intersections to allow storm runoff to stay within the proposed roadways and not into developable parcels. Mitigation measures will include the provision of storm drains and drywells at strategic locations to intercept storm runoff from the roadways and lead it into the ground. Bioretention, a BMP which was previously discussed, would also be a feasible application for the proposed development. Specific BMPs will be reviewed as part of the application for the National Pollutant Elimination System (NPDES) permit which will be required prior to the County’s issuance of a grading permit.

Page 4, Paragraph 3

We will consult with DOFAW and USFWS over potential impacts to listed species resulting from development of this property. The developer will develop and implement a Natural Resources Management Plan covering all listed species likely to be impacted following the development of a more detailed development plan.

The following text is added to Section 3.7.2, Fauna, to respond to your comment:

> The proposed brackish water pond area will provide additional habitat for shorebirds and some visiting seabirds. The creation of 19 acres of lagoons may result in impacts to two listed endemic waterbird species, including Black-necked Stilt (*Himantopus mexicanus knudseni*), and Hawaiian Coot (*Fulica alai*). It may also result in impacts to some migratory shorebird and waterfowl species protected under the Migratory Bird Treaty Act

> (MBTA). While the increase of habitat will benefit these species, there is also a possibility that these species may be exposed to activity that may harm them.
>
> The developer will consult with Kaloko-Honokohau National Historic Park, DOFAW and USFWS to develop a plan to establish a managed ecosystem and mitigate any potential impacts to listed species resulting from development of this property. A Natural Resources Management Plan that covers all listed species likely to be impacted following the development of a more detailed development plan will be prepared and implemented.
>
> The US Fish and Wildlife Service will be consulted under the Endangered Species Act, as well as the DLNR under HRS Section 195D.

Page 5, Paragraph 1

Please refer to our response related to alternatives analysis on page 4 of this letter.

Page 5, Paragraph 2

The following text has been added to Section 3.7.1 to address this comment:

> It is not expected that flora located west of the proposed harbor will be significantly impacted by possible changes in groundwater conditions due to harbor construction. This area averages 13 inches of rain a year, much of which percolates down to the water table. Also the native coastal plants that grow in the sand and coral areas cast up onto the lava shelf by west swell surf are not likely to be affected at all. Further, the native plants growing on the coastal strip are all widespread enough that the creation of the coastal buffer strip should provide them adequate consideration and protection.

Page 5, Paragraph 3 and 4

We will consult with DOFAW and USFWS over potential impacts to listed species resulting from development of this property. A Natural Resources Management Plan covering all listed species likely to be impacted will be developed and implemented following the development of a more detailed development plan.

Page 5, Paragraph 5

A predator control program at the Kona Kai Ola project site will be developed and implemented.

Page 5, Paragraph 6

Your comments regarding the potential harm to foraging stilts during construction is duly noted, and BMPs will be used to minimize shallow pooling of water, as well as to avoid and minimize potential harm.

Page 6, Paragraph 1

The project includes 7 acres for marina industrial uses, such as boat maintenance. Facilities that have the potential for be sources for pollutants will be identified and all appropriate mitigation measures will be identified, including BMPs.

Page 6, Paragraph 2

The nutrient loads that are causing increases from this project are coming from the brackish groundwater that will be intercepted in addition to the loads from the artificial lagoon system. However, mitigation measures discussed earlier serve to minimize this impact. In addition, Hawaii water quality standards are still measured by concentration, and the uptake by coral and benthic organisms is also governed by the concentration in the surrounding waters. While the need to assess mass loads into the surrounding water is understood, as long as ambient concentrations are kept within water quality standards, no additional impacts to the coastline or coral are expected.

The change in depth-averaged velocities at the entrance channel is shown in Chapter 6 of Appendix U. These depth average velocities are increased by at most 3-4 cm/s. Bottom velocities will have a smaller increase since the largest increase is observed at the surface. The change in velocities is mostly confined to the entrance channel.

Page 7, Paragraph 1

Mitigation measures to reduce the threat of species introduction, such as mollusks, algae, sponges and tunicates, will be developed and implemented prior to marina operations.

Page 7, Paragraphs 2 and 3

An additional survey of the anchialine pools in the southern complex was conducted as previously discussed. Attachment 2 contains Section 3.9.2, Anchialine Pools.

Page 7, Paragraph 4

Section 3.9.3, Marine Fishing Impacts, is revised to expand discussions on impacts on blue marlin:

> Anticipated Impacts
>
> The proposed marina will add 800 new slips to the existing facility. It is reasonable to assume that a portion of these new boats will engage in fishing activities. A study on the potential impact of these additional fishing boats on the marine fisheries is contained in Appendix R. Alternative 1 includes a 400 slip marina, so there would be a proportionate reduction in fishing pressure.
>
> While it is possible that an increase in the number of fishing boats would decrease CPUE, the overall impact on the health of the fishery from the proposed expansion of the marina is less clear. Even at a constant CPUE, the increase in the fish catch from charter boats will be a very small percentage of the total billfish and tuna catch over these Pacific-wide fisheries. The Kona fleet catches more blue marlin than any other trolling fleet in Hawai‘i, but in 2000 it only accounted for about 127,500 pounds of the 423,000 pounds caught by all anglers throughout the state and the additional 700,000 pounds landed by commercial long line fishermen in the state (Data from WestPac Year 2000 Recreational Fishing Summary). It is not likely that the fishing pressure from the expanded charter fleet will have an adverse impact on the Pacific-wide fishery.
>
> **Impacts on Marlin and Tuna / Pelagic Fishery**
>
> The impact on the marlin and tuna fisheries from increased harbor capacity will be a function of the number of new boats in the harbor targeting these fisheries and the ability of these new boats to attract paying customers. Both marlin and large tuna fisheries have been shown to be in general decline according to private, state, and national fisheries statistics. There are several hypothesized causes for these declines relating

primarily to international fisheries. The ability of the State to manage these pelagic marine fish stocks is limited by the national and international fishing policies.

Fisheries management typically attempts to reduce fishing pressure by limiting access to the fishery either through licensing, gear (boat) restrictions, catch limits, season or area limits. Limiting the number of boat slips available would not by itself provide effective control over fisheries pressure because these pressures are market driven, as well as for recreational and subsistence purposes, and there are other methods, such as boat launch ramps, to access the fishery.

Page 8, Paragraph 1

Section 3.9.3.3, Marine Fishing Impacts, Proposed Mitigation, has been revised to expand discussion on mitigation measures, as follows:

Proposed Mitigation

An increase in the harbor size offers the opportunity to consolidate, focus, and fund management and enforcement activities at one centralized location. The pressure on fish and invertebrate stocks, as well as upon populations of marine mammals and turtles can be expected to increase as the Kona population increases, regardless of whether the harbor is improved. The following changes could be made by DLNR, paid for at least in part by the additional revenues to DLNR from the Kona Kai Ola project. These changes are in the management authority of the DLNR Division of Aquatic Resources and the DLNR Division of Boating and Ocean Recreation.

Increase in the number of fisheries enforcement and management personnel in Kona at one centralized harbor location

- Allocation of slip and above commercial fishing, and subsistence fishing above recreational fishing office space for fisheries personnel and equipment
- Increased numbers of submerged mooring buoys (presently approaching 100) at all dive sites
- Increased education materials for recreational divers and fishermen
- Initiate restrictions on the quantity and size of boats in each commercial sector
- For inshore species, initiate catch restrictions in line with Division of Aquatic Resources guidelines that prioritize recreational fishing

Page 8, Paragraph 2

In response to DEIS comments, Marine Acoustics, Inc. conducted three studies related your comment, including the following:

- Description of Marine Mammal and Sea Turtle Species
- Acoustic Analysis of Potential Impacts (related to construction-generated underwater acoustics)
- Ambient Noise Measurements and Estimation Study

These studies are summarized in Section 3.9.4, Marine Mammals and Sea Turtles, which is included as Attachment 3.

Page 8, Paragraph 3

Available information on the proposed SWAC facility is summarized in Section 3.9.6, SWAC Facility, and a full discussion is presented in Appendix K, Cooling Water Intake Analysis (formerly Appendix J). Information related to the overall system process, water intake process, system infrastructure, possible impacts and mitigation measures in contained in both the EIS and the report. The level of detail you are requesting will be available in applications for permits, including a Conservation District Use Permit.

Page 8, Paragraph 4

As previously discussed, 2 additional studies on anchialine pools were conducted in response to DEIS comments. A summary of these studies is attached to this letter.

Page 9, Paragraph 1

Section 3.9.3, Marine Fishing Impacts, has been revised to expand discussion on SCUBA diving and coral reefs, as follows:

> Impacts on Coral Reef From Extractive Fisheries
>
> It is possible that a large number of boat slips in the expanded harbor will be occupied by resident-owned motor boats for personal use. Private boats in Hawai'i are used for a variety of activities that have historically proven difficult to regulate. These may include extractive activities such as bottom fishing, trolling, spear fishing, tropical fish and invertebrate collecting, as well as non-extractive activities including sport diving, skiing, paragliding, racing, or shoreline transportation. Each of these activities has individual existing impacts upon marine resources and these impacts are expected to increase with the new harbor unless appropriate management is initiated.
>
> There is a general perception that the increased access to nearshore resources will result in a decline in these fish stocks similar to that seen historically on O'ahu. This perception is not without merit and deserves serious attention from resource managers. However, the increased access to the shoreline has already occurred, and will continue as the coastline is developed regardless of harbor development. As most fisheries are market driven, as well as for recreational and subsistence purposes, there will be increased pressure on these resources in the future regardless of harbor development. Fisheries managers need to take a serious look at management strategies for the future. Attempting to preserve fisheries resources only by limiting the size of the harbor is not likely to have any positive long term effect on the nearshore living marine resources because there are increasingly other avenues to access the shorelines.
>
> SCUBA
>
> An increase in the number of boat slips is likely to cause an increase in both the number and size of commercial moored vessels offering dive tours as well as private boats used for diving. Although all of the dive sites in Kona are relatively near shore, the lack of shoreline access and ease of entry by boat makes boat diving the preferred option. As more of the Kona coast becomes developed however, this shoreline limitation to dive sites is likely to decrease. Attempting to limit dive pressure on the reef by limiting the number of available slips is not by itself an effective long-range management tool. As the number of divers on the reef increases, the pressure on the reef from anchor damage, extractive fisheries, and unintentional diver induced coral damage will likely increase. The increased pressure on dive sites from SCUBA divers must be met with commensurate changes in management to limit adverse impacts.

Page 9, Paragraph 2

Section 4.6.5, Work Force Housing, has been added to the EIS to include discussion on worker housing, as follows:

Workforce Housing Impacts

In response to DEIS comments, a study of possible workforce requirements and related secondary impacts was conducted by The Hallstrom Group; this study is presented in Appendix C-2. This study was based on a four-step study process that included 1) quantification of population and employment projections, 2) .analysis of West Hawai‘i employment demand and supply, 3) characterization of the subject workforce, and 4) quantification of subject workforce housing impacts.

The population and job count on the Hawai‘i Island are forecast to increase by approximately 70 percent during the 24 year projection period that ends in 2030. On average, at least 60 percent of the population growth will be a result of net in-migration to the County.

Although trends will be slowing relative to recent decades, a significant portion of the population and business expansion will be directed towards West Hawai‘i. In the next two decades, the population and job count in West Hawai‘i will increase by about 80 percent, reaching 128,200 residents and 87,400 employment positions by 2030. The available approved or entitled, proposed and announced new projects and their associated forecast job creation supply will not be sufficient to meet estimated employment demand over time. Further, with the approaching build-out of the major West Hawai‘i resorts and residential-orientation of the newer resort communities, few opportunities will exist for expansion in the historically-vital tourism economic sector.

As discussed in Section 4.6.3.2, implementation of the Kona Kai Ola master plan will create a total of 3,842 on-site full time equivalent employment positions in the operating businesses of the development. The project is estimated to be operational around 2012, following completion of infrastructure and Phase I construction, and will continue until the community reaches build-out and stabilization in 2026.

Approximately 45 percent of the jobs will be entry level positions with an average annual wage of $20,000 in current dollars. Another 40 percent will be mid-level jobs with average yearly pay of $32,000, and, 15 percent will be management/high-skill positions with wages averaging $50,000.

Approximately 2,147 of the jobs in the subject project will be filled by persons who have in-migrated to the Big Island. However, only a nominal portion would be specifically relocated to West Hawai‘i as a result of the development.

The total net housing load created by Kona Kai Ola in-migrant workers will be 1,074 units. This in-migration will generate a need for a range of 625 to 859 affordable housing units, as follows:

As discussed in Section 4.5.2.2, under Hawai‘i County Ordinance Chapter 11, Section 4 Affordable Housing Requirements, hotel uses generating more than 100 employees on a full-time equivalent basis must earn one affordable housing credit for every four full-time equivalent jobs created. Application of the "1 to 4" ratio to all of the transient units proposed for Kona Kai Ola (hotel and time-share) results in a workforce housing requirement of 625 units.

Another method of calculating the need for affordable worker housing units is to estimate that approximately 80 percent of the total in-migrant worker need housing that meet affordable housing pricing guidelines. This results in a high end range of 859 units.

Based on affordable housing pricing guidelines, affordable housing units will have an estimated sales price of $216,000 to $292,000.

As agreements between the State and JDI prohibit residential development at Kona Kai Ola, workforce housing would need to be located off-site. Probable and desirable locations for workforce housings were based on availability, efficiencies and surveys conducted of area workers. Possible locations in support of Kona Kai Ola included the mid-elevation lands of the Keahole to Kailua-Kona Corridor, between the Queen Ka‘ahumanu fronting commercial/industrial developments and Mamalahoa Highway; and in the Waikoloa Village expansion areas.

The most suitable location for workforce housing units is the Villages at La‘i‘Opua community, a DHHL project, or within the Hawai‘i Housing Finance and Development Corporation affordable housing development planned for Keahuolu. These are two State-owned undertakings directly across the highway in the same ahupua‘a . Locating workforce affordable housing units in these communities would substantially lessen the traffic impacts associated with a community subject workforce. Alternatively, the State lands adjacent to Waikoloa Village would be appropriate.

JDI will comply with all affordable housing requirements of applicable Hawai‘i County ordinances.

Page 9, Paragraph 3

The vision for Kona Kai Ola is to develop a project that has minimal impact on the environment by striving to significantly reduce water consumption, waste disposal, energy use and carbon dioxide emissions. Section 1.5.6, Waste Related Goals, has been added to present information on project efforts to reduce waste, and the following is an excerpt:

- The project will divert over 50 percent of the waste generated during construction. The preparation of a site and the eventual construction of buildings and site infrastructure generate significant amounts of waste. By identifying construction and site materials that can be reused or recycled on or off-site, the Kona Kai Ola project will reduce construction waste by at least 50 percent. Prior to the beginning of construction activities, a construction waste management plan will be developed that will lead to a 50 percent reduction in construction waste. Polluted runoff will be treated using structural and non-structural Best Management Practices before the water is released to the marina.

Page 9, Paragraph 4

Initial coordination with DLNR has identified two possible sources that may possibly be used for the project. DLNR anticipates a sustainable yield of each well to be approximately 1.5 million gallons per day.

- Keopu Well #2 (State Well No. 3957-02)
- Keopu Well #4 (State Well No. 3857-02)

The proposed water system will also include transmission and storage facilities. Initial communications with Queen Lili‘uokalani Trust indicates an interest in partnering with Kona Kai Ola and allowing the needed transmission main corridor/easement through their property. However, the Queen Lili‘uokalani Trust has not yet identified a development proposal on their property to the south. Water transmission corridors may alternately be coordinated with the State Department of Transportation as part of their highway improvements. While discussions continue with the Queen Lili‘uokalani Trust, the storage tank that will serve the project will be located either on TMK 7-4-08:56 or 7-4-20:22.

Page 10, Paragraph 1

In response to DEIS comments, a harbor water quality study was conducted, and is included as Attachment 4 of this letter.

The classification designations for the waters in and surrounding Honokohau Harbor are based on nutrient concentrations. The additional loads to the system are primarily a result of the additional groundwater that is intercepted, and the nutrients contained within that water. Additional loads are only added from the artificial lagoon system. Alternatives assessing the impacts associated with that lagoon system are presented in Chapter 5 of Appendix U. However, the proposed expansion attempts to mitigate additional loads as well as eliminate existing loads as much as possible.

The nutrient loads that are causing increases from this project are coming from the brackish groundwater that will be intercepted in addition to the loads from the artificial lagoon system. However, mitigation measures discussed above serve to minimize this impact. In addition, Hawaii water quality standards are still measured by concentration, and the uptake by coral and benthic organisms is also governed by the concentration in the surrounding waters. While the need to assess mass loads into the surrounding water is understood, as long as ambient concentrations are kept within water quality standards, no additional impacts to the coastline or coral are expected.

Page 10, Paragraphs 2 and 4

As previously discussed, the second survey of anchialine pools found that 3 of the previously identified pools are part of an estuary complex. The DEIS prematurely stated that the remaining pools would be destroyed and subsequent studies found that the project may or may not negatively affect anchialine pools. Please refer to previous responses regarding anchialine pools, as well as the attachment discussing anchialine pools.

Page 10, Paragraph 3

Please refer to our previous response on increased diver density.

Page 10, Paragraphs 5 to 9 and Page 11, Paragraph1

The initial study focused on the water quality and biological communities in anchialine ponds and the overall intent of the surveys was to quantitatively describe existing water quality and benthic community conditions and to identify potential impacts associated with the proposed development. The study used appropriate methodology.

An additional study of anchialine pools in the southern complex was conducted in response to DEIS. All pools were visually inspected each day and night at or near mean higher high tide periods. Further discussion on anchialine pools is contained in the attachment summarizing findings of the additional study.

Page 11, Paragraph 2

The sampling techniques used have long been established in the literature and have been shown to be both repeatable and reliable within statistical limits when performed by competent surveyors.

Page 11, Paragraph 3

Impacts related to harbor outflow were studied in the Harbor Water Quality Modeling Study, which is attached to this letter. Findings indicate that, with Alternative 1, which is a smaller marina, harbor water quality would remain the harbor system and in the surrounding waters remained similar to existing conditions.

Page 11, Paragraphs 1 to 3, and Page 12 Paragraph 1

As discussed earlier, EIS discussion related to mammals and sea turtles has significantly increased based on the addition of three studies. These studies are summarized in Section 3.9.4, Marine Mammals and Sea Turtles, which is included as Attachment 3.

Page 12, Paragraphs 2 to 4

As discussed earlier, the EIS has expanded discussion on several areas, and the attachments contain information derived from these studies. More detailed information will be developed in consultation with the appropriate agencies and as the project proceeds in the permitting process.

Your comment letter and this response are included in the Final Environmental Impact Statement. We appreciate your participation in the environmental review process. Please submit a request to our office if you would like to receive a printed or electronic copy of the Final Environmental Impact Statement, or portions thereof.

Sincerely,

Dayan Vithanage, P.E., PhD.
Director of Engineering

cc: Office of Environmental Quality Control
State Department of Hawaiian Home Lands
Jacoby Development, Inc.

Attachment 1

2 Alternatives Analysis

~~In typical land development projects, the initial planning process includes the exploration of alternatives to development objectives. In the EIS process, these alternatives are presented with a disclosure of reasons for the dismissal of non-preferred alternatives.~~

~~Kona Kai Ola does not follow this same pattern of alternatives evaluation.~~ As discussed in Section 1.4, the proposed Kona Kai Ola project is the result of agreements between JDI and the State DLNR and DHHL. The agreements and leases between the State and JDI stipulate the parameters of development for this site in terms of uses, quantities and size of many features, resulting in a limited range of land uses. Unlike a private property project, JDI is required to meet the criteria outlined in the agreements, thereby affording less flexibility in options and uses. From the developer's perspective, the agreements must also provide sufficient flexibility to allow for a development product that responds to market needs and provides a reasonable rate of return on the private investment.

The agreements between JDI and DLNR specify that the proposed harbor basin is to be 45 acres and accommodate 800 slips. This development proposal is the subject of this EIS. In response to DEIS comments, additional water quality studies and modeling were conducted. These studies determined that the water circulation in a 45-acre 800-slip marina would be insufficient to maintain the required standard of water quality. The models of water circulation suggest that a new 25-acre harbor basin could successfully maintain required water quality in the new harbor. Comments on the DEIS from DLNR, from other government agencies, the neighbors and the general community also called for the consideration of alternatives in the EIS, including a project with a smaller harbor basin and less density of hotel and time-share units.

In response to these comments on the DEIS, three alternatives are evaluated in this Final EIS and include Alternative 1, which is a plan with a 25-acre 400-slip harbor basin including a decrease in hotel and time-share units; Alternative 2, which is an alternative that had been previously discussed but not included in the proposed project, that includes an 800-slip harbor and a golf course; and Alternative 3, the no-project alternative. Each alternative is included in the EIS with an evaluation of their potential impacts. These project alternatives are presented to compare the levels of impacts and mitigation measures of the proposed project and alternative development schemes pursuant to requirements set forth in Chapter 343, HRS.

~~JDI is required to provide a new marina basin not less than 45 acres and a minimum of 800 new boat slips. Further, the agreements provide the following options for land uses at the project site:~~

- ~~Golf Course~~
- ~~Retail Commercial Facilities~~
- ~~Hotel Development Parcels~~
- ~~Marina Development Parcels~~
- ~~Community Benefit Development Parcels~~

~~JDI is not pursuing the golf course option and is proposing instead to create various water features throughout the project site. All other optional uses have been incorporated in Kona Kai Ola.~~

2.1 Project Alternatives

2.1.1 Alternative 1: 400-Slip Marina

Studies conducted in response to DEIS comments found the construction and operation of an 800-slip marina may significantly impact the water quality within the marina and along the shoreline. Specifically, the Harbor Water Quality Modeling Study, as contained in Appendix U, found that the water circulation in a 45-acre 800-slip harbor was insufficient to maintain an acceptable level of water quality. Further, the existing harbor channel, which would serve both the existing and new harbors, could not adequately serve the increased boat traffic generated by an 800-slip marina during peak traffic. Mitigation measures to accommodate peak boat traffic included the widening of the existing channel, an action that would entail a complex process of Federal and State approvals and encounter significant environmental concern.

Concerns related to the proposed density of hotel and time-share units were also expressed in comments to the DEIS from members of the public, neighbors to the project site, especially the Kaniohale Community Association, and government agencies. Common themes in DEIS comments were related to impacts regarding traffic, project requirements of potable water and infrastructure systems, including sewer, drainage, utility and solid waste systems, and socioeconomic impacts.

In response to the water quality study results, and to the DEIS comments, an alternative plan was developed with a smaller marina with less boat slips, and a related decrease in hotel and time share units. Illustrated in Figure G, Alternative 1 reflects this lesser density project, and features a 400-slip marina encompassing 25 acres. For the purposes of the Alternative 1 analysis, JDI assumed 1,100 time-share units and 400 hotel rooms. Project components include:

- 400 hotel units on 34 acres
- 1,100 time-share units on 106 acres
- 143 acres of commercial uses
- 11 acres of marina support facilities
- 214 acres of parks, roads, open spaces, swim lagoons and community use areas

In addition, Alternative 1 would include the construction of a new intersection of Kealakehe Parkway with Queen Ka'ahumanu Highway, and the extension of Kealakehe Parkway to join Kuakini Highway to cross the lands of Queen Lili'uokalani Trust, and connecting with Kuakini Highway in Kailua-Kona. This is a significant off-site infrastructure improvement and is included in the agreements between the State and JDI.

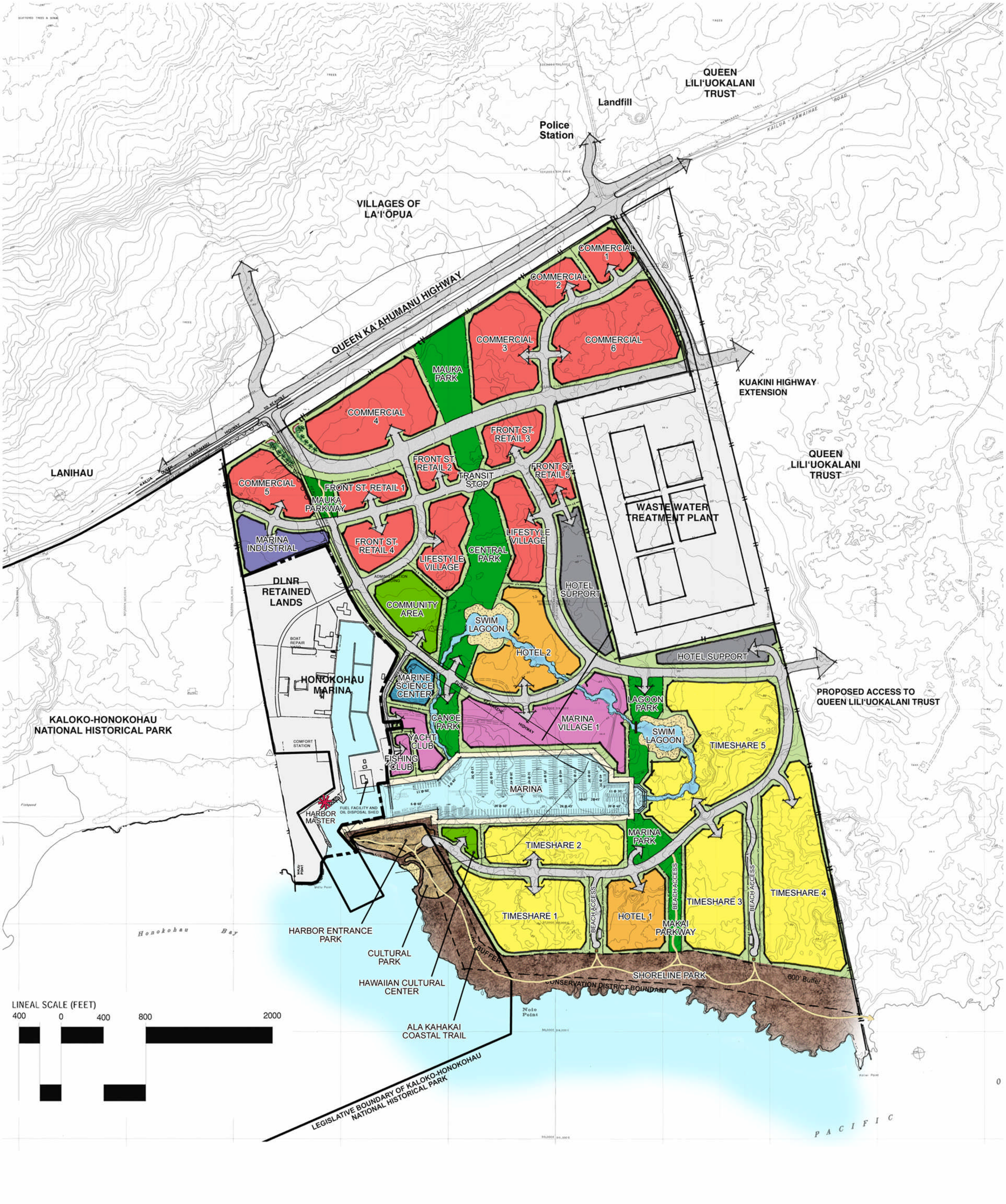

Figure G: Alternative 1: 400-Slip Marina

LEGEND

TIME SHARE	MARINA SUPPORT / COMMERCIAL	UTILITIES
HOTEL	MARINE SCIENCE CENTER	PARKS & GREEN SPACE
RETAIL / COMMERCIAL	COMMUNITY AREA / CULTURAL CENTER	SHORELINE
MARINA RETAIL	SWIM LAGOON	HARBOR ENTRANCE PARK / CULTURAL PARK
	MARINA	

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JDI
JACOBY DEVELOPMENT, INC.

Like the proposed project, Alternative 1 would have a strong ocean orientation, and project components that support this theme would include various water features including seawater lagoons and a marine science center. The new Alternative 1 harbor would include a yacht club, fishing club, a canoe park, and a cultural park with a focus on Hawaiian maritime cultural heritage of the voyaging canoe. The coastal area would be protected with a shoreline park with trails and public access parking for walking and shoreline fishing, and a cultural park surrounding the heiau, the cultural sites and ‘Alula for community use. Additional Alternative 1 community areas would include facilities and space for community use, including programs of the Kona Kai Ola Community Foundation, which supports community programs in health care, culture, education, and employment training for the local community, especially to native Hawaiians. Like the original proposed plan, Alternative 1 includes 40 percent of the land in parks, roads, open spaces, swim lagoons and community use areas.

2.1.2 Alternative 2: Golf Course Feature

Alternative 2 was among the alternatives discussed at a community charrette in September 2003. It includes a golf course, which is a permitted use in the DLNR agreement and DHHL lease. As Figure H illustrates, an 18-hole championship golf course would occupy 222 acres on the southern portion of the project site. As with the proposed project, Alternative 2 includes an 800-slip marina on a minimum of 45 acres.

To support the economic viability of the project, other Alternative 2 uses include:

- Golf course clubhouse on three acres
- 1,570 visitor units on 88 acres fronting the marina
- 118 acres of commercial uses
- 23 acres of community uses

Community uses in Alternative 2 include an amphitheater, a canoe facilities park, a community health center, a Hawaiian cultural center and fishing village, a marine science center and employment training center. The sea water lagoon features contained in the proposed project and Alternative 1 are not included in this alternative.

2.1.3 Alternative 3: No Action

In Alternative 3, the project site would be left vacant, and the proposed marina, hotel and time-share facilities, commercial and marina industrial complexes, and community-oriented uses would not be realized.

~~The economic viability and sustainability of the project is determined by the density and uses proposed. Because JDI is obligated to develop an 800-slip marina for the State, complete road improvements, and provide various public enhancement features at its own expense, the density proposed for the income generating features of the development must be sufficient to provide an acceptable level of economic return for JDI. The market study, which is discussed in Section 4.6, reviewed various development schemes and determined that the currently proposed density and mix is the optimum to meet the anticipated financing and development cost obligations for the public features associated with the development.~~

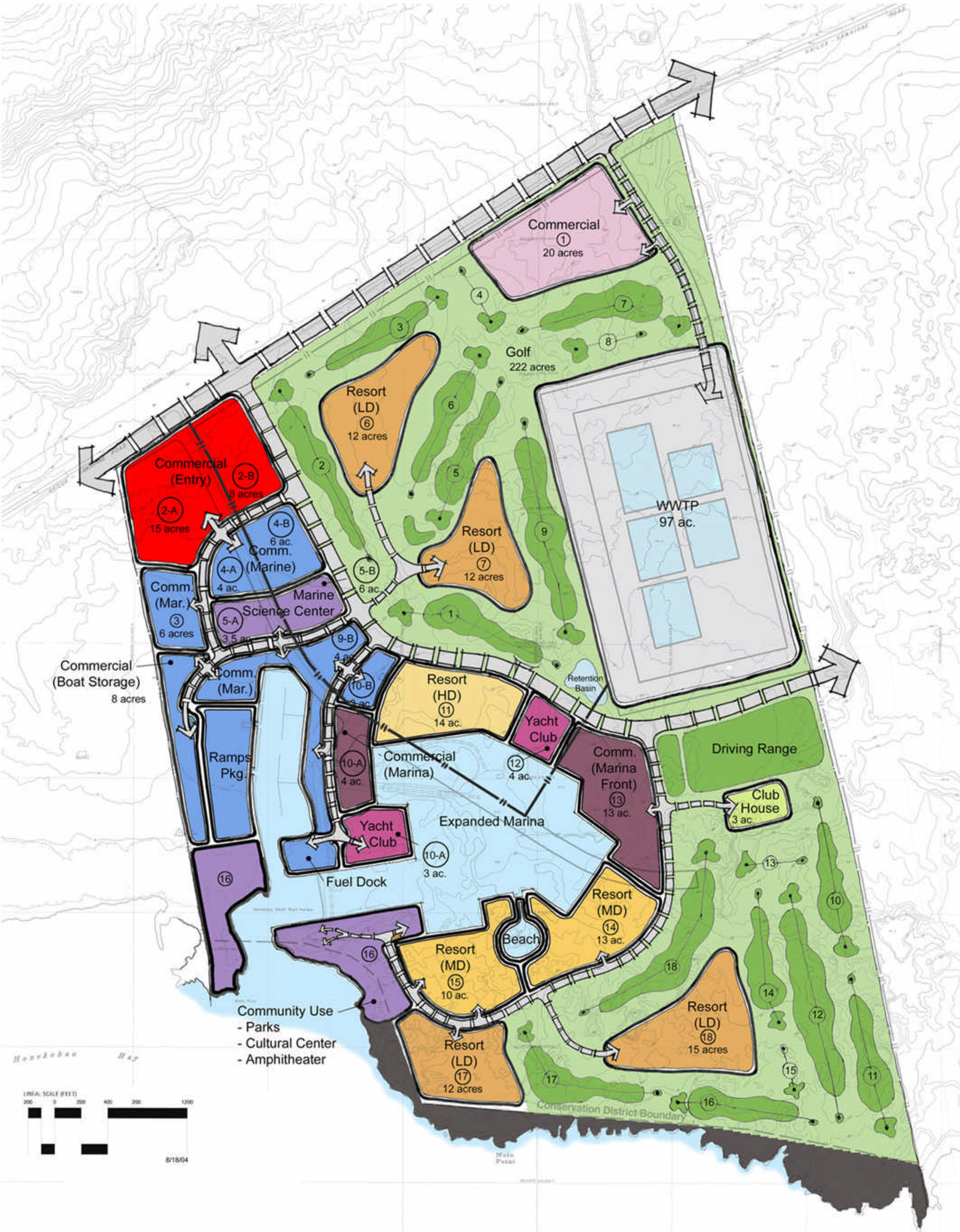

Figure H. Alternative 2: Golf Course Alternative

Legend

N E S W

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2.2 Alternatives Analysis

As discussed in Section 2.1, the proposed Kona Kai Ola project (also referred to as "proposed project") is defined by development requirements related for a marina and the related uses that would be needed to generate a reasonable rate of return that covers development costs.

Beginning with Section 2.2.1, the alternative development concepts are comparatively assessed for potential impacts that may reasonably be expected to result from each alternative. Following is an overview of the primary observations of such assessment.

Alternative 1 includes half of the State-required boat slips and 60 percent of the proposed hotel and time-share units and, due to the decreased density, this alternative would generate significantly less environmental and socio-economic impacts. A harbor water quality model found the reduction of the volume of the new marina basin by about half (approximately 25 acres) significantly improved the water circulation and quality. Further, the reduced number of boat slips would generate less boat traffic, thereby reducing congestion and the need to mitigate impacts further by the widening of the existing harbor channel.

A project with fewer hotel and time-share units and increased commercial space with a longer (14 years) absorption period would change the mix of employment offered by the project, and slightly increase the overall employment count. The public costs/benefits associated with Alternative 1 would change, compared to the proposed project, with a general increase in tax collections, and a general decrease in per capita costs. Detailed discussion of Alternative 1 potential economic impacts are provided in Section 4.6.6. Comparisons of levels of impact are presented throughout this FEIS.

While this analysis might indicate that the 25-acre marina in Alternative 1 would be the more prudent choice, the DLNR agreement establishes the minimum size and slip capacity of the marina at 45 acres and 800 slips, respectively. Amendments to the DLNR agreement would be required in order to allow Alternative 1 to proceed as the preferred alternative. Hence, selection of the preferred alternative is an unresolved issue at the writing of this FEIS.

Alternative 2, the golf course alternative, was not previously considered to be the preferred alternative primarily because market conditions at the time of project development might not likely support another golf course. Further, DHHL has a strategy goal to have more revenue-generating activities on the commercial lease lands within the project area. In addition, concerns have been expressed as to environmental impacts of coastal golf courses, including the potential adverse impact on Kona's water supply if potable water is used for golf course irrigation.

While Alternative 3, the no-project alternative, would not generate adverse impacts related to development of these lands associated with the construction and long-term operations, it would also not allow for an expanded public marina that would meet public need and generate income for the public sector. Further, the no-project alternative would foreclose the opportunity to create a master-planned State-initiated development that would result in increased tax revenue, recreation options and community facilities. Crucial privately-funded improvements, such as the marina, regional roadway and circulation improvements, and improvements to the existing wastewater treatment plant, would not be implemented. Private funds toward the development of community-oriented facilities such as parks, other recreational facilities, and public access would not be contributed.

~~Hence, the only valid alternative to the proposed project is the no-action alternative. In this alternative, the project site would be left vacant, and the proposed marina, hotel and time-share facilities, commercial and marina industrial complexes, and community-oriented uses would not be realized.~~

~~The no-project alternative would therefore not generate adverse impacts associated with the construction and long-term operations would not occur.~~

~~Likewise, the creation of a master-planned state-initiated development, resulting in increased employment, tax revenue, recreation options and community facilities, would not be created. Privately-funded improvements, such as the marina, regional roadway and circulation improvements, and improvements to the existing wastewater treatment plant, would not be implemented. Private funds toward the development of community-oriented facilities such as parks, other recreational facilities and public access would not be contributed.~~

Further, the creation of revenue-producing businesses on the DHHL property to fund homestead programs would not occur, resulting in fewer potential benefits for Hawaiians.

Hence, the agreements and leases between the State and JDI indicate that the no-action alternative is not in the public interest~~has been rejected at this time~~.

2.2.1 Impact Comparison

Grading and Excavation

The proposed project requires grading and excavation. Both actions may impact groundwater due to rainfall runoff during construction. Alternative 1 would require a significantly smaller excavation for the marina basin and would therefore carry a lesser risk of potential adverse effects on water quality. Alternative 2 would require the same basin excavation as the proposed project, and would also include extensive grading and filling to build the golf course, the latter of which would generate additional impacts. Alternative 3 would result in no change to the geography, topography and geology.

Further discussion on grading and excavation is contained in Section 3.3.

Natural Drainage

Most precipitation infiltrates into the porous ground at the site, and no significant sheet flow is likely. Alternative 1 would generate similar levels of impacts on natural drainage as those of the proposed project and thus require similar mitigation measures. The golf course in Alternative 2 would not be as porous since the site would be graded, soil would be placed, and grass and other landscaping would be grown. Sheet flow and runoff can occur on a golf course, and drainage patterns might change. Alternative 3 would result in no change to the existing natural drainage pattern. Further discussion on natural drainage is contained in Section 3.4.

Air Quality

Air quality will be affected by construction activities, as well as pollutants from vehicular, industrial, natural, and agricultural sources. Alternative 1 would generate less construction air quality impacts than the proposed project due to the reduced amount of intensive groundwork associated with the smaller marina basin and fewer long-term impacts by reducing traffic 35 and 40 percent during, respectively, AM and PM peak traffic times. Construction of Alternative 2 would result in fugitive dust and exhaust from equipment and is expected to generate the same level of air quality impact as the proposed project. Alternative 3 would result in no change to existing air quality. Further discussion on air quality is contained in Section 3.5.

Terrestrial Environment

To provide additional habitat for shorebirds and some visiting seabirds, the project proposes to construct a brackishwater pond area suitable for avian fauna, including stilts, coots and ducks. While habitat expansion is beneficial, there is also a possibility that these species may be exposed to activity that may harm them. Alternative 1 would not include a brackish water pond, but will include 5 acres of seawater features, which is 74 percent less than the 19 acres of seawater features in the proposed project. While this would reduce beneficial impacts, it would also decrease exposure to potentially harmful activity. Alternative 2 does not include the brackish water pond features, but would include drainage retention basins that would attract avian fauna and expose them to chemicals used to maintain golf course landscaping. While Alternative 3 would result in no increase in potentially harmful activity, it would also not provide additional habitat for avian fauna. Further discussion on the terrestrial environment is contained in Section 3.7.

Groundwater

Groundwater at the project site occurs as a thin basal brackish water lens. It is influenced by tides and varies in flow direction and salt content. The existing Honokōhau Harbor acts as a drainage point for local groundwater. Any impact to groundwater flow from the proposed harbor is likely to be localized. The proposed marina basin will not result in any significant increase in groundwater flow to the coastline, but rather a concentration and redirection of the existing flows to the harbor entrance.

There will be differences in the flow to the marina entrance between the proposed project and Alternative 1. Alternative 1, being smaller in size, will have less impact on groundwater flow than the proposed marina. Alternative 2 will have a similar impact to groundwater quality as the proposed project. Alternative 2 may also impact water quality by contributing nutrients and biocides to the groundwater from the golf course. Alternative 3 would result in no change in existing groundwater conditions. Further discussion on groundwater is contained in Section 3.8.1.

Surface Water

There are no significant natural freshwater streams or ponds at the site, but there are brackish anchialine pools. Surface water at the project site will be influenced by rainfall. Runoff typically percolates rapidly through the permeable ground. The proposed project will include some impermeable surfaces, which together with building roofs, will change runoff and seepage patterns.

Alternative 1 is a lower density project that is expected to have proportionally less impact on surface water and runoff patterns and less potential impact on water quality than the proposed project. Alternative 2 would have more impact on surface water quality than the proposed project due to fertilizers and biocides carried by runoff from the golf course. Alternative 3 would result in no change to surface water conditions. Further discussion on surface water is contained in Section 3.8.2.

Nearshore Environment and Coastal Waters

The potential adverse impacts to the marine environment from the proposed project are due to the construction of an 800-slip marina and the resulting inflow of higher salinity seawater and inadequate water circulation, both of which are anticipated to impair water quality to the extent of falling below applicable standards. One possible mitigation measure is to significantly reduce the size of the marina expansion.

The reduced marina size (from 45 to 25 acres) and reduced lagoon acreage in Alternative 1 are expected to result in a proportionate reduction in seawater discharging into the new harbor and increased water circulation. Alternative 2 includes the same marina basin size and is therefore subject to the same factors that are expected to adversely affect water quality.

In the existing Honokōhau Harbor, water quality issues focus on the potential for pollutants, sediments, mixing and discharge into the nearshore marine waters. Before the harbor was constructed, any pollutants entrained within the groundwater were believed to have been diffused over a broad coastline.

The water quality in the proposed harbor depends on several components. These include salinity, nutrients, and sediments that come from the ocean, rainfall runoff, water features with marine animals, and dust. The smaller project offered as Alternative 1 is expected to produce a reduced amount of pollutants and reduce the risk of adverse impact upon water quality.

It is notable that the 45-acre marina basin planned in the proposed project and Alternative 2 only becomes viable from a water quality impact standpoint if the additional brackish groundwater inflow into the new marina exceeds 60 mgd. The resulting flushing from such inflow would be expected to better maintain water quality. However, it is unclear whether 60 mgd of brackish groundwater would be available. As proposed in Alternative 1, reduction of the volume of the new marina basin by 45 percent will significantly improve the flushing and water quality because the lower volume can be flushed by the available groundwater flow.

In addition, there could be higher rainfall runoff from the Alternative 2 golf course into the harbor, because the grassed golf course will be less porous than the natural surface. The golf course will also require relatively high levels of fertilizer, biocides, and irrigation, all of which could contribute to adverse water quality impacts.

Further discussion on nearshore environment and coastal waters is contained in Section 3.9.1.

Anchialine Pools

Anchialine pools are located north of Honokōhau Harbor, and south of the harbor on the project site. The marine life in these pools is sensitive to groundwater quality, and changes due to construction and operation of the project could degrade the viability of the pool ecosystem. In the southern complex, 3 anchialine pools with a combined surface area of $20m^2$ would be eliminated due to the harbor construction in the proposed project and Alternatives 1 and 2.

Predicting the extent of change in groundwater flow is difficult if not impossible even with numerous boreholes and intense sampling. The actual flow of groundwater towards the sea is minimal today, and tidal measurements show that tide fluctuations represent more than 90 percent in actual harbor tides. The fluctuations occur simultaneous with the ocean/harbor tide, which indicate a vertical and horizontal pressure regime between bore hole 6 and the ocean and harbor. Hence, the tides alone create a mixing system that increases salinity, as the flow approaches the point of discharge which will be either the channel or the shore. Another factor that could influence groundwater quality is the increased local recharge from irrigation between the channel and shore. This will add fresh water to the lens locally but is not quantified at this time.

Quantification of these impacts, including the flow of groundwater through each pond, is therefore extremely difficult. The shallow lavas are of the pahoehoe type and have a relatively high horizontal permeability. In surface depressions or undulations, the pahoehoe lavas have a tendency to lose vertical permeability from sedimentation thus restricting water exchange within the individual pools. This is normally reflected in both the salinity and temperature and this information has been adequately studied in the pools.

Changes in groundwater quality may or may not impact biological communities in the anchialine and estuarine environment. In either case, it is important to understand these relationships to effectively manage the resource. If there is significant deviation from the baseline especially in regard to nutrients, pathogens, and toxins, a mitigation plan to determine the cause and take decisive appropriate action will be implemented.

Due to the uncertainty of changes in groundwater flow and quality due to marina construction, the variability in impacts between the proposed project and Alternatives 1 and 2 is unknown at this time. Alternative 3 would result in no change in groundwater flow. While this would eliminate the potential for adverse impacts, Alternative 3 would also continue the pattern of existing degradation related to human activity and the introduction of alien species. Further discussion on anchialine pools is contained in Section 3.9.2.

Marine Fishing Impacts

The proposed marina will increase the number of boats in the area and it is reasonable to assume that a portion of these new boats will engage in fishing activities. The increase in boats in the area would be primarily related to the marlin and tuna / pelagic fishery, coral reefs due to extractive fisheries, and SCUBA activities. The pressure on fish and invertebrate stocks is expected to increase with or without the marina. Harbor expansion provides the opportunity to address existing conditions to consolidate, focus, and fund management and enforcement activities at one location.

Compared to the proposed project, Alternative 1 would result in a 21 percent decrease in boat traffic, thereby lessening the potential for marine fishing impacts. The level of impacts in Alternative 2 would be similar to that of the proposed project. Alternative 3 would result in no change in existing marine fishing conditions, and no opportunity to address already existing pressure on fish and invertebrate stocks. Further discussion on marine fishing impacts is contained in Section 3.9.3.

Cultural and Archaeological Resources

The proposed project will integrate cultural and archaeological resources in the overall development. Archaeological sites recommended for preservation will be preserved, and cultural practices will be encouraged. Kona Kai Ola includes a canoe park, and a cultural park with a focus on Hawaiian maritime cultural heritage of the voyaging canoe. Proposed is a 400-foot shoreline setback that would serve as a buffer between the ocean and developed areas. This coastal area would be protected with a shoreline park with trails and public access parking for walking and shoreline fishing, and a cultural park surrounding the heiau, the cultural sites and ‘Alula for community use.

Alternative 1 would contain all of the cultural archaeological features and the shoreline setback area would be 400 feet in the northern portion of the site and increase to 600 feet in the southern portion. Alternative 2 would preserve cultural and archaeological resources, but does not include a 400-foot shoreline setback. Alternative 3 would result in no change to existing cultural and archaeological resources and no addition of cultural and community facilities and activities. Further discussion on cultural and archaeological resources is contained in, respectively, Sections 4.1 and 4.2.

Noise

Project-generated noise is due to construction equipment and blasting, boats, marina activities, vehicle traffic, and the Kealakehe Wastewater Treatment Plant operations. Alternative 1 would generate less noise impacts due to reduced construction activities, fewer boats, less traffic and less on-site activity. Alternative 2 would also generate less noise due to reduced traffic and less on-site activity, but noise related to the excavation of the marina basin and an increase in the number of boats would be similar to that of the proposed project. Further discussion on noise impacts is presented in Section 4.4.

Socioeconomic Impacts

The proposed project will generate an increase in de facto population of an estimated 5,321 persons due to the increase in hotel and time-share units. The estimated de facto population increase in Alternative 1 is 37 percent less, at 3,363 persons, than the proposed project. The de facto population increase in Alternative 2 is similar to Alternative 1.

Employment in the commercial components will nearly double in Alternative 1, from a stabilized level of 1,429 full-time equivalent (FTE) positions in the proposed project to 2,740 in the Alternative 1.

Under Alternative 1, the total operating economic activity at Kona Kai Ola will increase due to the added commercial space more than off-setting the fewer visitor units, moving upward from $557.6 million per year to circa $814.3 million annually. The total base economic impact resulting from development and operation of Alternative 1 will similarly be higher by between 35 and 45 percent than that of the proposed project.

Alternative 1, which has a reduced marina size of 25 acres, and fewer hotel and time-share units, would have a meaningful market standing, create significant economic opportunities, and provide a net benefit to State and County revenues. From a market perspective, a smaller Kona Kai Ola would still be the only mixed use community in the Keahole to Kailua-Kona Corridor offering competitive hotel and time-share product.

The estimated absorption periods for marketable components of Alternative 1 are generally shorter than those for the same components in the proposed project. Marina slips under Alternative 1 are estimated to be absorbed within 2 years after groundbreaking, as compared with 9 years for absorption of slips in the proposed project. Hotel rooms under Alternative 1 are estimated to be absorbed within 4 years after groundbreaking, as compared with 7 years under the proposed project. Time-share units would be absorbed within 10 years under Alternative 1, while 15 years are projected under the proposed project. Due to the planned increase in commercial facilities under Alternative 1, the absorption period of commercial space is estimated at 14 years, as compared with 8 years for absorption of such facilities under the proposed project.

The State and County will still both receive a net benefit (tax receipts relative to public expenditures) annually on a stabilized basis under the Alternative 1. The County net benefits will be some $12.2 million per year under the Alternative 1 versus $14.9 million under the proposed project. The State net benefits will increase under the Alternative 1 to about $37.5 million annually, up substantially from the $11.4 million in the proposed project.

Due to the lower de facto population at build-out, the effective stabilized public costs for both the State and County will decline meaningfully under the Alternative 1, dropping from $7.7 million annually for the County and $36.5 million for the State, to $4.9 million and $23 million per year, respectively.

Alternative 3 would result in no increase in de facto population and improvement to economic conditions. Further discussion on social and economic impacts are contained in, respectively, Sections 4.5 and 4.6.

Vehicular Traffic

The proposed project will impact the nearby road network that currently is congested during peak traffic times. The proposed project includes roadway improvements that would reduce the impact and improve roadway conditions for the regional community.

Alternative 1 includes the same roadway system improvements as the proposed project, yet would reduce vehicular traffic by 35 percent when compared to the proposed project. Alternative 2 would have similar traffic conditions and roadway improvements as Alternative 1. Alternative 3 would result in no increase in traffic and no roadway improvements.

Marina Traffic Study

The increase in boat traffic due to the proposed 800-slip marina would cause entrance channel congestion during varying combinations of existing and new marina peak traffic flow. Worst case conditions of active sport fishing weekend and summer holiday recreational traffic result in traffic volumes exceeding capacity over a short afternoon period. Mitigation to address boat traffic in the proposed project include widening the entrance channel, traffic control, implementation of a permanent traffic control tower, or limiting vessel size.

Alternative 1 would result in a 21 percent reduction in boat traffic congestion under average existing conditions and ten percent reduction during peak existing conditions. The reduction to 400 slips also reduces the impacts of congestion at the entrance channel, thereby reducing the need for any modifications to the entrance channel.

Alternative 2 would have the same level of boat traffic as the proposed project. Alternative 3 would not meet the demand for additional boat slips and would not generate additional boat traffic. Further discussion on marina traffic is contained in Section 4.8.

Police, Fire and Medical Services

The proposed project will impact police, fire and medical services due to an increase in de facto population and increased on-site activity. Alternatives 1 and 2 would have similar levels of impact as the proposed project due to increased on-site activity. Further discussion on police, fire and medical services are contained, respectively, in Sections 4.10.1, 4.10.2 and 4.10.3.

Drainage and Storm Water Facilities

The proposed project will increase drainage flows, quantities, velocities, erosion, and sediment runoff.

Alternative 1 involves a reduction of the project density that would reduce storm runoff from the various land uses due to a reduction in impervious surfaces associated with hotel and time-share development and to the creation of more open space. However, roadway areas will increase by about 30 percent in Alternative 1. Storm runoff from proposed streets would therefore increase; thus requiring additional drainage facilities and possibly resulting in no net savings. The golf course in Alternative 2 may also change drainage characteristics from those of the proposed project and may not reduce impacts. Alternative 3 would result in no change in existing conditions and no improvements to drainage infrastructure. Further discussion on drainage and storm water facilities is contained in Section 4.10.5

Wastewater Facilities

The proposed development is located within the service area of the Kealakehe WWTP and a sewer system will be installed that connects to the WWTP. The sewer system will be comprised of a network of gravity sewers, force mains, and pumping stations which collect and convey wastewater to the existing Kealakehe WWTP. Project improvements will incorporate the usage of recycled / R1 water. Improvements implemented by the proposed project will also accommodate the needs of the regional service population.

Alternative 1 would generate approximately 10 percent less wastewater flow than the proposed project. Wastewater flow in Alternative 2 is undetermined. Alternative 3 would result in no additional flow, as well as no improvements that will benefit the regional community. Further discussion on wastewater facilities is contained in Section 4.10.6.

Potable Water Facilities

The proposed project average daily water demand is estimated at 1.76 million gallons per day. Existing County sources are not adequate to meet this demand and source development is required. The developer is working with DLNR and two wells have been identified that will produce a sustainable yield that will serve the project. These wells will also serve water needs beyond the project.

Alternative 1 would result in net decrease of about five percent of potable water demand. Alternative 2 may have a lower water demand than the proposed project as long as potable water is not used for irrigation. Alternative 3 would result in no additional flow, as well as no source development that will benefit the regional community. Further discussion on potable water facilities is contained in Section 4.10.8.

Energy and Communications

Regarding Alternative 1, preliminary estimates for electrical, telecommunications, and cable resulted in a net demand load that remains similar to the proposed project. Further discussion on energy and communications is contained in Section 4.10.9.1.

The proposed project will increase the demand for electrical energy and telecommunications. The demand would be reduced in Alternative 1 because the number of boat slips and units would decrease. Similarly, Alternative 2 would have fewer units than the proposed project and therefore reduce energy demands. Further reduction in energy demand for either alternative could be achieved by using seawater air conditioning (SWAC) and other energy reduction measures, as planned by the developer. Further discussion on energy and telecommunications is contained in Section 4.10.9.2.

Water Features and Lagoons

The proposed project includes a brackishwater pond, lagoons, and marine life exhibits supplied by clean seawater. The water features in Alternative 1 would significantly decrease by 74 percent from 19 acres in the proposed project to five acres in Alternative 1. This decrease in water features would result in a corresponding decrease in water source requirements and seawater discharge. Alternative 2 does not include the seawater features. Alternative 3 would result in no additional demand for water source requirements and seawater discharge.

2.2.2 Conformance with Public Plans and Policies

State of Hawai‘i

Chapter 343, Hawai‘i Revised Statutes

Compliance with this chapter is effected, as described in Section 5.1.1 in regard to the proposed project and the alternatives discussed.

- State Land Use Law, Chapter 205, Hawai‘i Revised Statutes

  The discussion in Section 5.1.2 is directly applicable to Alternative 1, the proposed project. Alternative 1 will involve a setback of 400 feet that increases to 600 feet along the southern portion of the project site’s shoreline area. Alternative 2 does not provide for such a setback, but may still require approvals from DLNR for cultural, recreational, and community uses and structures within the Conservation district.

- Coastal Zone Management Program, Chapter 205A, Hawai‘i Revised Statutes

  Recreational Resources:

  In addition to the discussion of consistency with the associated objective and policies, as described in Section 5.1.3, the reduction from the proposed project’s 800-slip marina to a 400-slip marina under Alternative 1 will still expand the region’s boating opportunities and support facilities. The existing harbor entrance will still be utilized under this alternative; however, potential risks relating to boat traffic and congestion in the marina entrance area will be reduced significantly. The 400-600 foot shoreline setback, public parks, trails, cultural areas, community facilities, and marine science center remain important recreational components under Alternative 1.

Alternative 2 includes a golf course component, which would add a more passive recreation to the active and social components, such as boating, fishing, swimming, trails, walkways, parks, marine life, educational and interactive areas that are also part of the project. The golf course would enhance the range of leisure and recreational opportunities offered at Kona Kai Ola.

Alternative 2, like the proposed project, will expand the region's boating opportunities and support facilities through its 800-slip marina. However, the potential adverse impacts of increased boat traffic from the size of the marina are significant enough to offset the benefits of increased boating opportunities.

Coastal Ecosystems:

The discussion in Section 5.1.3 is directly applicable to Alternative 1.

Alternative 1 not only reduces the number of slips proposed by 50 percent, but it also reduces the size of the marina from 45 acres to 25 acres. The 25-acre marina will increase the body of water within the existing harbor, but to a significantly lesser extent than the proposed project's estimated increase, which is also applicable to the 45-acre size that is proposed for the marina under Alternative 2.

The findings of the Harbor Water Quality Modeling Study conclude that a reduction in the size of the harbor expansion is an alternative that will mitigate the risk of significant impacts upon water quality within the marina and existing harbor. Accordingly, the reduction in both the number of slips and the size of the marina basin under Alternative 1, in combination with proper facilities design, public education, and enforcement of harbor rules and regulations, would result in fewer long-term impacts to water quality and coastal ecosystems. Short-term (construction-related) impacts would likely remain the same although the reduction in the total acreage of excavation is expected to result in a shorter duration of such impacts.

In addition to its 800-slip marina and potential adverse impacts upon water quality and the marine environment, Alternative 2 includes a golf course component, which has the potential to impact coastal ecosystems by increasing the nutrient loading in surface runoff and groundwater and also by introducing pesticides, herbicides, and other chemicals common in golf course use and management into the nearshore waters surrounding the project site.

Economic Uses

Although reduced in the number of slips, the smaller marina under Alternative 1 will nevertheless serve public demand for more boating facilities in West Hawai‘i and is consistent with the objective and policies and discussion set forth in Section 5.1.3. The economic impacts of Alternative 2, while comparable to those of the proposed project's marina development, are notably marginal as to the golf course component, based on the marketability analysis that indicates a condition of saturation within the region.

Coastal Hazards

The discussion and considerations set forth in Section 5.1.3 are also applicable to Alternatives 1 and 2 and indicate compliance with the objective and policies addressed. Tsunami risks mainly affect the large shoreline setback area that is proposed for the project and Alternative 1. Alternative 2 projects a transient accommodation site that is partially within the tsunami hazard zone and thus carries a higher hazard risk. However, the essential requirement for these alternatives, as well as the proposed project, is a well-prepared and properly implemented evacuation plan.

Beach Protection

Discussion and considerations set forth in Section 5.1.3 are also applicable to Alternatives 1 and 2 and indicate compliance with the objective and policies addressed. Alternative 1 and, to a lesser extent, Alternative 2, will retain the shoreline area in its natural condition.

Similar to the proposed project, Alternative 1 provides for a shoreline setback of considerable width within which no structure, except for possible culturally-related structures, would be allowed. Alternatives 1 and 2 will thus be designed to avoid erosion of structures and minimize interference with natural shoreline processes.

Marine Resources

The discussion in Section 5.1.3 is also applicable to Alternative 1 which is described to be an alternative that is specifically projected to mitigate anticipated adverse impacts on water quality and the marine environment that might otherwise result from the original harbor design and scale, which is also incorporated in Alternative 2 . The reduced marina size under Alternative 1 is projected to meet water quality standards and enable greater compliance with the objective and policies addressed in this section.

Alternative 2 includes a golf course component and thus the potential to adversely impact marine resources by increasing the nutrient loading in surface runoff and groundwater and also by introducing pesticides, herbicides, and other chemicals common in golf course use and management into the nearshore waters surrounding the project site.

Hawai'i State Plans, Chapter 226, Hawai'i Revised Statutes

Section 226-4 (State goals), 5 (Objectives and policies for population, and 6 (Objective and policies for economy in general):

The discussion in Section 5.1.4 is applicable to Alternatives 1 and 2, in addition to the proposed project. These development concepts generally conform to the goals, objectives, and policies set forth in these sections because they will provide some degree of economic viability, stability, and sustainability for future generations. Kona Kai Ola will convert essentially vacant land into a mixed-use development with a distinctive marina and boating element, providing a wide range of recreational, business, and employment opportunities to the community.

Section 226-8 Objective and policies for the economy – the visitor industry:

Alternatives 1 and 2 will be consistent with the State's economic objective and policies relating to the tourism industry for the same reasons that are discussed in regard to the proposed project in Section 5.1.4. They will incorporate JDI's commitment to sustainability principles in the planning and design of the development concepts in Alternatives 1 and 2. Although the total hotel and time-share unit count is reduced to approximately 1,500 in Alternatives 1 and 2, the transient accommodations component of these alternatives will still further the State's objective and policies for increased visitor industry employment opportunities and training, foster better visitor understanding of Hawai'i's cultural values, and contribute to the synergism of this mixed-use project concept that addresses the needs of the neighboring community, as well as the visitor industry.

Section 226-11 Objectives and policies for the physical environment: land-based, shoreline and marine resources:

Alternative 1 is expected to involve less potential adverse impacts upon these environmental resources than the proposed project. Likewise, and Alternative 2 would have less adverse impact because of its reduction in the size of the marina and in the total hotel and time-share unit count. Alternative 1 carries less potential risk to water quality and related impacts upon the marine environment and anchialine pool ecosystems. Although approximately three anchialine pools are expected to be destroyed, the great majority of pools will be preserved within and outside of the proposed 400-foot shoreline setback.

The golf course component in Alternative 2 has the potential to impact marine resources by increasing the nutrient loading in surface runoff and groundwater and also by introducing pesticides, herbicides, and other chemicals common in golf course use and management into the marina basin and nearshore waters surrounding the project site. It also has the potential to adversely affect the anchialine pools by introducing the chemicals into the pond systems.

Section 226-12 Objective and policies for the physical environment: scenic, natural beauty, and historic resources:

The discussion in Section 5.1.4 is directly applicable to Alternative 1 and describes the compliance with the objective and policies addressed.

The golf course component of Alternative 2 would create a park-like view that would potentially enhance the beauty of the project site and surrounding areas when considered in combination with the existing rugged natural beauty of the area.

Just as with the proposed project, Alternatives 1 and 2 would also be designed to blend with the natural terrain and to honor and protect the cultural history, resources, and practices of these lands.

Section 226-13 Objectives and policies for the physical environment: land, air and water quality:

As stated above, because of the reduction in both the number of slips and the size of the marina basin, with proper facilities design, public education and enforcement of harbor rules and regulations, Alternative 1 is anticipated to cause fewer long-term impacts to water quality than either the proposed project or Alternative 2. Based on the findings of the Harbor Water Quality Modeling Study, water quality resulting from a reduced marina basin size as proposed under Alternative 1 is expected to be similar to existing conditions.

As previously noted, Alternative 2 has the potential to adversely impact water quality by increasing the nutrient loading in surface runoff and groundwater by introducing pesticides, herbicides and other chemicals common in golf course development and maintenance into the marina basin and nearshore waters surrounding the project site.

Section 226-14 Objectives and policies for facility systems - general:

Alternatives 1 and 2 will conform to the objective and policies of this section on the grounds that are discussed in regard to the proposed project in Section 5.1.4. The master-planning and phasing of the project concepts under these alternatives will be coordinated with associated public and private infrastructural planning and related private and public infrastructural financing. The cost of the marina construction and project-related infrastructure is to be borne by the developer, resulting in considerable savings for the public. In addition, the projected lease revenue from these public lands will provide additional public benefits by establishing a revenue stream for capital improvements and maintenance of a range of State facilities.

Section 226-15 Objectives and policies for facility systems - solid and liquid wastes:

In addition to the developer's commitment to sustainable development design, the project will involve upgrades to the County of Hawai'i's Kealakehe Wastewater Treatment Plant to meet current needs, as well as the project's future needs. This commitment is applicable to Alternatives 1 and 2, as well as the proposed project that is discussed in Section 5.1.4.

Section 226-16 Objectives and policies for facility systems – water:

The discussion of water conservation methods and the need to secure additional potable water sources in Section 5.1.4 is also applicable to Alternative 1 and demonstrates conformity to the objective and policies for water facilities. Alternative 2 involves greater irrigation demands in regard to its golf course component and greater potable water demands for human consumption than those for Alternative 1. Alternative 2 is expected to face more serious challenges in securing adequate and reliable sources of water.

Section 229-17 Objectives and policies for facility systems – transportation:

Alternatives 1 and 2 will conform to this objective and policies because they will present water transportation opportunities, including the possible use of transit water shuttles to Kailua-Kona, as described in regard to the proposed project in Section 5.1.4.

Section 226-18 Objectives and policies for facility systems – energy:

Alternatives 1 and 2 conform to these objective and policies through the use of energy efficient design and technology and commitment to the use and production of renewable energy to serve the project's needs. Solar energy production, solar hot water heating, and the use of deep cold seawater for cooling systems are currently identified as means of saving substantial electrical energy costs for the community and the developer.

Section 226-23 Objectives and policies for socio-cultural advancement – leisure:

Alternative 1 conforms to this objective and related policies for the reasons offered in Section 5.1.4 in regard to the proposed project. Alternative 1 will be of greater conformity with the policy regarding access to significant natural and cultural resources in light of the 400-600 foot shoreline setback that has been designed for this alternative.

Although it does not propose the considerable shoreline setback that is planned for Alternative 1, Alternative 2 is consistent with this objective and related policies in incorporating opportunities for shoreline-oriented activities, such as the walking trails. In addition, the golf course component adds a more passive recreation alternative to the active and social components, such as boating, fishing, swimming, trails, walkways, parks, marine life educational and interactive areas that are also part of the project. The golf course would enhance the range of leisure and recreational opportunities offered at Kona Kai Ola.

Section 226-25 Objectives and policies for socio-cultural advancement-culture:

The discussion in Section 5.1.4 is relevant to Alternatives 1 and 2 and demonstrate their conformity the objective and policies of this section.

Both alternatives involve the preservation and protection of cultural features that have been identified by the Cultural Impact Assessment and archaeological studies for the project area. Both provide for public shoreline access, and both will continue the policy of close consultation with the local Hawaiian community and cultural and lineal descendants in the planning of cultural resource preservation and protection.

Section 226-103 Economic priority guidelines:

Alternatives 1 and 2 conform to these guidelines for the same reasons that are set forth in Section 5.1.4. They involve private investment in a public project that will create economic diversification through a mix of marina, industrial, commercial, visitor, and cultural facilities. This presents a wide range of entrepreneurial opportunities, long-term employment opportunities, and job training opportunities.

Section 226-104 Population growth and land resources priority guidelines:

As described in Section 5.1.4, the policy support for the proposed project also extends to the similar development concepts considered in Alternatives 1 and 2. Those alternatives conform to the guidelines of this section because they involve an urban development under parameters and within geographical bounds that are supported by the County's General Plan, a preliminary form of the Kona Community Development Plan, the County's Keahole to Kailua Regional Development Plan, and the reality of being located along the primary commercial/industrial corridor between Keahole Airport and Kailua-Kona. As with the proposed project, the development concepts of Alternatives 1 and 2 are essentially alternatives for the implementation and "in-filling" of the urban expansion area in North Kona.

DHHL Hawai'i Island Plan

This 2002 plan projects DHHL's Honokōhau makai lands for commercial use. As compared to the proposed project and Alternative 2, Alternative 1 presents an expanded commercial component that provides greater compliance with the plan, while addressing certain beneficiaries' concerns about the scale of the marina originally required in the Project. Alternative 2 also conforms to the recommended commercial uses in the makai lands but to a lesser degree than Alternative 1 because of its more limited commercial component. Like the proposed project, its marina size and number of slips raise environmental issues, as more specifically discussed in Part 3, and community concerns.

County of Hawai'i General Plan

HCGP Section 4 – Environmental Quality Goals, Policies and Courses of Action:

Alternative 1 is consistent with this section. It presents a reduction in both the number of slips and the size of the marina basin that, in combination with proper facilities design, public education and enforcement of harbor rules and regulations, would result in very few long term impacts to water quality. Based on the findings of the Harbor Water Quality Modeling Study, water quality would remain similar to existing conditions.

Alternative 2 is the least consistent with this section. In addition to the potential significant impacts of its 800 slip marina basin, its golf course component has the potential to adversely impact marine resources by increasing the nutrient loading in surface runoff and groundwater and also by introducing pesticides, herbicides and other chemicals common in golf course use and management into the nearshore waters surrounding the project site. It also has the potential to adversely affect the anchialine pools beyond their current conditions by introducing such substances into the pool systems.

HCGP Section 7 – Natural Beauty Goals and Policies:

Alternative 2 conforms to some degree with this section. Its golf course component would create a park-like view that would potentially enhance the beauty of the project site and surrounding areas when considered in combination with the existing rugged natural beauty of the area, as demonstrated in other makai golf courses within the region.

HCGP Section 8 – Natural Resources and Shoreline:

Alternative 1 is most consistent with the goals and policies of this section. It would require considerably less marina excavation than the proposed project and Alternative 2 and would reduce the potential risk of long-term adverse impacts to water quality. Based on the findings of the Harbor Water Quality Modeling Study, water quality would remain similar to existing conditions with the degree of reduction in marina basin size that is proposed under Alternative 1. This reduction is also expected to reduce potential impacts upon anchialine pools and their ecosytems, as well as shoreline and marine resources that are affected by water quality. Alternative 1 also retains the shoreline preservation and protection concepts that are proposed in and described for the Project.

HCGP Section 10 – Public Facilities Goals and Policies:

The discussion in Section 5.2.1. in relation to the proposed project is applicable to Alternatives 1 and 2. Improvements to public facilities are are integral to the Kona Kai Ola development. The provision of additional boat slips and numerous road improvements, including a makai extension of Kuakini Highway south to Kailua-Kona are incorporated into plans for the project's development. In light of these elements, Alternatives 1 and 2 are consistent with the goals and policies of this section.

HCGP Section 11 – Public Utility Goals, Policies:

As with the proposed project, Alternatives 1 and 2 are consistent with the goals and policies of this section, based on the relevant grounds set forth in Section 5.2.1. The developer is committed to design, fund, and develop environmentally sensitive and energy efficient utility systems to the extent possible, as described previously in Part 5. Its master planning provides for the coordinated development of such systems with the objective of achieving significant savings for the public. As previously-mentioned example, the project development involves the upgrading of the Kealakehe Wastewater Treatment Plant.

HCGP Section 12 – Recreation:

Alternative 1 is consistent with the goals, policies, and courses of action for North Kona in this section.

Although the number of slips is reduced under Alternative 1, the region's boating opportunities and support facilities will still be expanded. The existing marina entrance would still be utilized under this alternative. However, concerns relating to increased activity leading to increased congestion in the marina entrance area would be mitigated to a certain extent. The 400-600 foot shoreline setback, public parks, trails, cultural areas, community facilities and marine science center remain important components of Alternative 1.

The golf course component of Alternative 2 would add a more passive recreation to the active and social components, such as boating, fishing, swimming, trails, walkways, parks, marine life, educational and interactive areas that are also part of the project. The golf course would enhance the range of leisure and recreational opportunities offered at Kona Kai Ola. Alternative 2 is also considered to be consistent with this section.

HCGP Section 13 and 13.2 – Transportation:

The reduced marina component under Alternative 1 will still provide transportation opportunities and provide for possible use of transit water shuttles to Kailua-Kona, although to a lesser degree than under the proposed project and Alternative 2 . However, in each scenario, internal people-movers are planned, and numerous roadway improvements are planned for coordination with public agencies, including but not limited to the construction of the Kuakini Highway extension between Honokōhau and Kailua-Kona. Accordingly, both Alternatives 1 and 2 are consistent with the goals, policies, and courses of action for North Kona under these sections of the General Plan.

HCGP Section 14.3 – Commercial Development:

For the reasons presented in the discussion under Section 226-104 of the State Plan, the planned commercial component under Alternatives 1 and 2 are consistent with this section.

HCGP Section 14.8 – Open Space:

Alternatives 1 and 2 are consistent with the goals and policies of this section. Alternative 1 provides a considerable (400-600 foot) shoreline setback along the entire ocean frontage of the project site as a means of protecting the area's scenic and open space resources, as well as natural and cultural resources. Although it does not incorporate the shoreline setback planned in Alternative 1, Alternative 2 provides a golf course component would contribute to the amount of open space that is currently proposed and allow additional view corridors to be created.

Community Development Plans

Community development plans are being formulated for different regions in the County in order to supplement the County's General Plan. The Kona Kai Ola project is located in the Kona Community Development Plan (CDP) area. Maps associated with the preliminary work phases

of the Kona CDP include the Kona Kai Ola project site within the "Preferred Urban Growth" boundary of the North Kona district. The Kona CDP process is guided by a Steering Committee composed of a broad cross-section of the community. The Steering Committee will eventually complete its work and recommend the CDP's adoption.

After the DEIS was published, the Kona CDP has progressed to the development of plans for the major urban growth corridor north of Kailua-Kona. The Kona CDP has produced a draft plan showing a transit oriented development that includes a midlevel public transit corridor along the mauka residential elevation, and a makai transit corridor that runs along a proposed new frontage road just makai and parallel to Queen Kaahumanu Highway. The development plan for Alternative 1 includes the Kuakini Highway as part of this proposed frontage road and transit line from Kailua Kona to the Kealakehe area, along with a transit stop at Kona Kai Ola. The Alternative 1 plan also includes a road that could be extended to be part of the proposed frontage road should it be approved and implemented. In addition, the Kona CDP has continued to emphasize the principles of smart growth planning with mixed use urban areas where people can live, work, play and learn in the same region. Kona Kai Ola has been specifically designed to be consistent with this policy in order to provide a stable employment base close to where people live in the mauka residential areas already planned for DHHL and HHFDC lands.

It should be noted that currently and over the years, the 1990 Keāhole to Kailua Development Plan (K-to-K Plan) guides land use actions by the public and private sectors. It is intended to carry out the General Plan goals and policies related to the development of the portion of North Kona area, including the Kona Kai Ola site. The "Preferred Growth Plan" of the Keāhole to Kailua Development Plan identifies the project site as a new regional urban center to include commercial, civic, and financial business related uses, an expanded "Harbor Complex," a shoreline road, and a shoreline park. The proposed project and the development concepts in Alternatives 1 and 2 are therefore consistent with the recommendations in the Keāhole to Kailua Development Plan.

Hawaiʻi County Zoning

As shown on Figure AA, the project site is zoned "Open". Under Section 25-5-160 of the Hawaiʻi County Code, "The O (Open) district applies to areas that contribute to the general welfare, the full enjoyment, or the economic well-being of open land type use which has been established, or is proposed. The object of this district is to encourage development around it such as a golf course and park, and to protect investments which have been or shall be made in reliance upon the retention of such open type use, to buffer an otherwise incompatible land use or district, to preserve a valuable scenic vista or an area of special historical significance, or to protect and preserve submerged land, fishing ponds, and lakes (natural or artificial tide lands)".

Some of the proposed uses at Kona Kai Ola are permitted uses in the Open zone such as:

- Heiau, historical areas, structures, and monuments;
- Natural features, phenomena, and vistas as tourist attractions;
- Private recreational uses involving no aboveground structure except dressing rooms and comfort stations;

- Public parks;
- Public uses and structures, as permitted under Section 25-4-11.

In addition to those uses permitted outright, the following uses are permitted after issuance of a use permit:

- Yacht harbors and boating facilities; provided that the use, in its entirety, is compatible with the stated purpose of the O district.
- Uses considered directly accessory to the uses permitted in this section shall also be permitted in the O district.

The proposed time-share and hotel units and commercial uses would not be consistent with the zoning designation of "Open". Project implementation therefore requires rezoning of portions of the project to the appropriate zoning category or use permits for certain uses.

Special Management Area

As shown in Figure AB, the entire project area up to the highway is within the coastal zone management zone known as the Special Management Area ("SMA"). At the County level, implementation of the CZM Program is through the review and administering of the SMA permit regulations. Kona Kai Ola complies with and implements the objectives and policies of the Coastal Zone Management (CZM) Program, and a full discussion is provided in Section 5.1.3. The development concepts in the proposed project and Alternatives 1 and 2 will be subject to applicable SMA rules and regulations.

Attachment 2

The conditions with the project constructed were found to be phosphorous limited. Several simulations were performed including and excluding the inflow from the marine exhibits which provides an additional nitrogen load and also varying the location of this inflow. It was found that the inflow from the marine exhibits can have a beneficial effect on flushing, especially when positioned within the existing harbor basin. However, its effect is significantly less than the effect due to the brackish groundwater inflow. When the exhibit inflow is excluded or positioned at the east end of the new marina, its effect is small in terms of flushing due to its high salinity. From a water quality perspective, since the loads from the exhibit inflow consist primarily of nitrogen, it does not cause increased algae growth. However, this exhibit inflow does raise the concentrations of ammonia and nitrate in the system.

Simulation results indicate that under the conditions when the post-expansion system receives an additional brackish inflow into the new 25-acre marina on the order of 30 mgd or more, water quality within the harbor system and in the surrounding waters remained similar to existing conditions. These conditions are expected to occur based on the findings reported by Waimea Water Services (2007), which states that the proposed marina would exhibit the same or similar flushing action as the existing marina.

An additional mitigation measure proposed by Waimea Water Services (2007), if sufficient inflow is not intercepted, consists of drilling holes in the bottom of the new marina to enhance this inflow and facilitate flushing within the proposed system.

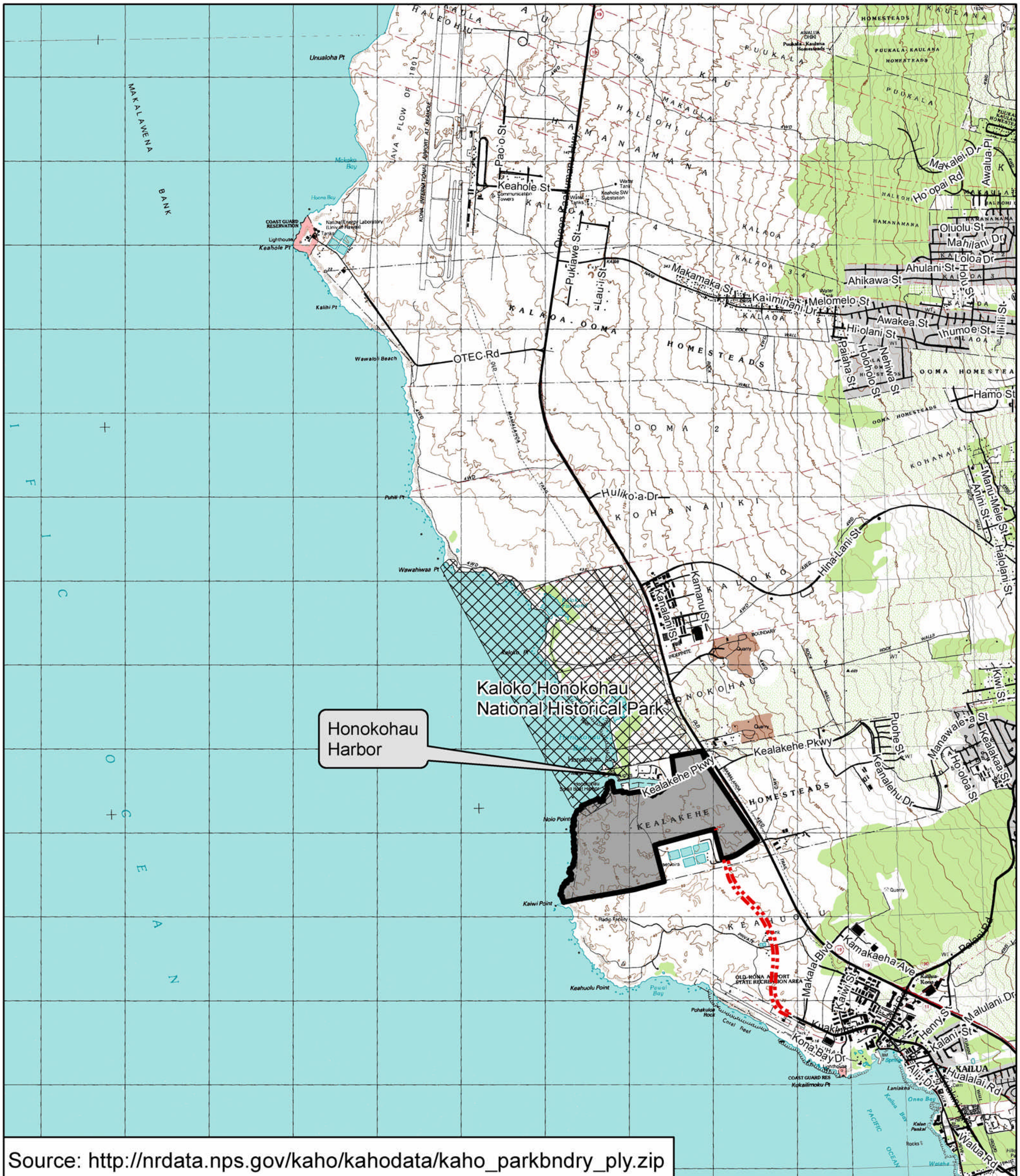
~~3.9.3~~3.9.2 Anchialine ~~Ponds~~ Pools

Two studies on anchialine pools were conducted in this EIS process. The anchialine ~~ponds~~ pools water quality studies and ~~biota surveys were conducted by David A. Ziemann, Ph.D. of the Oceanic Institute and is~~biota surveys were conducted by David A. Ziemann, Ph.D. of the Oceanic Institute in October 2006 and are included as Appendix ~~G~~H-1. That survey included pools located both north and south of Honokōhau Harbor. In response to DEIS comments and to further study the pools south of entrance channel of Honokōhau Harbor, a second study was conducted by David Chai of Aquatic Research Management and Design in June 2007. The second survey focused on intensive diurnal and nocturnal biological surveys and limited water quality analysis of the southern group of anchialine pools exclusively. The report is contained in Appendix H-2.

~~3.9.3.1~~3.9.2.1 Existing Conditions

Anchialine ~~ponds~~ pools exist in inland lava depressions near the ocean. Two anchialine ~~pond~~ pool complexes are located immediately to the north and south of the Honokōhau Harbor entrance channel. The complex to the north is located wholly within the designated boundaries of the Kaloko-Honokōhau National Historical Park as shown in Figure Q~~O~~. Many of the ~~ponds~~ pools in the southern complex are within the park administrative boundary as well. ~~Ponds~~ Pools in the northern complex show little evidence of anthropogenic impacts. Many contain typical vegetation and crustacean species in high abundance.

Figure R locates anchialine pools near the harbor entrance and pools~~Ponds~~ in the southern complex are depicted in Figure S.



Source: http://nrdata.nps.gov/kaho/kahodata/kaho_parkbndry_ply.zip

Figure Q: National Historical Park Service Legislative Boundary Map

Legend

- Project Site
- Proposed Parkway
- National Park Boundary

0 2,500 5,000 Feet

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innovation through engineering & scientific excellence

JDI
JACOBY DEVELOPMENT, INC.

Source: Oceanic Institute

Figure R: Anchialine Pool Locations

N
W E
S

0 2,000 4,000 Feet

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JDI

JACOBY DEVELOPMENT, INC.

Source: Aquatic Resources Management And Design

Figure S: Anchialine Pool Locations in Southern Complex

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The 2006 study identified 22 pools in the southern complex. The 2007 study found that three of the 22 pools are part of an estuary complex with direct connection to the ocean. While there were several signs of direct human use and disturbance, such as trash receptacles and toilet facilities, the greatest degradation to the majority of the anchialine and estuarine resources was due to the presence of alien fish, including topminnows and tilapia, and introduced plants, predominantly pickleweed and mangrove. ~~are moderately to heavily impacted, with many containing exotic fish that exclude the anchialine crustaceans. The ponds also show evidence of human impact, including discarded bottles, cans, wrappers, diapers, toilet paper, etc. Water quality conditions within the ponds generally reflect the conditions of the underlying groundwater.~~

~~Figure P locates anchialine ponds near the harbor entrance. The study conducted as a part of this EIS show that the anchialine ponds south of the harbor entrance are moderately to heavily impacted by human activities and introduced fish populations. The study found that the nitrogen phosphorus concentrations in these ponds are significantly higher compared to the ponds north of the harbor entrance. The sources of these additional nutrients are not known. Continuous influx of nutrients will eventually degrade the water quality to levels that could alter the pond ecology.~~

Biota surveys in the two pond systems clearly indicate that counts of typical pond denizens show a remarkable difference between the northern and southern ~~ponds~~ pools. In the northern ~~ponds~~ pools the number of *Halocaridina rubra* ranged from a low of 20–25 to too numerous to count. The biota rich pond bottoms appeared red due to the *Halocaridina rubra* numbers. The only other species visible was the predatory shrimp *Metabetaeus lohena*. In contrast, only four out of the 22 ~~ponds~~ pools examined in the southern pond complex showed a decreased presence of *Halocaridina rubra* (6 to 200) individuals in the pond, and three ~~ponds~~ pools contained *Metabetaeus lohena*. Eight of the ~~ponds~~ pools contained numbers of introduced minnows which is an apparent predator of *Halocaridina rubra* and *Metabetaeus lohena*.

The 2007 study found three of the pools identified in the 2006 study were part of an estuary complex with direct connection to the ocean, and that the southern complex contained 19 anchialine pools. The study further found that a majority of the southern pools are degraded biologically and physically, primarily due to the effects of introduced fish and plant species. Six pools are currently devoid of alien fish, but they face a high level of threat due to the proximity of pools that have these species. Of the 19 anchialine pools, six were considered high tide pools (exposed only at medium or high tide), seven were considered pool complexes (individual pools at low tide and interconnected at high tide), and six were single isolated pools. Of the 19 anchialine pools, three pools with a combined surface area of $20m^2$ would be eliminated due to the harbor construction.

The DEIS presented information stating that harbor construction would cause an increase in salinity in the anchialine pools makai of the proposed marina basin to become equivalent to the ocean at 35 ppt. and that the anchialine biology would then perish. There is currently a level of uncertainty by professional hydrologists as to the exact movement of surface groundwater and final determination of anchialine salinity following the harbor construction. The assessment that all anchialine pools will be barren with the construction of the harbor may be premature. *Halocaridina rubra* (opae ula) are routinely drawn from high salinity wells at 30-32 ppt.

Within the 19 pools, native and non-native fauna included 14 species comprised of 5 fish, 2 mollusca, and 6 crustacea. Algae within the pools primarily consisted of a mixed assemblage of diatoms and cyanobacteria, with several pools dominated by matted filamentous *Cladophora*, sp. The darker cave/overhang pools and high tide pools had epilithic *Hildenbrandia* sp. covering the rock substrate. Riparian vegetation was dominated by introduced species consisting of Pickleweed (*Batis maritima*), Mangrove (*Rhyzophora mangle*), and Christmasberry (*Shinus terebenthifolius*). Only two species of native plants Akulikuli (*Sesuvium portulacastrum*) and Makaloa (*Cyperus laevigatus*) existed near the pools and comprised only few small patches and a single tuft (respectively).

Most of the hypogeal anchialine shrimp have adapted to the presence of minnows by foraging in the pools at night. During daylight hours, only the adult shrimp appear to coexist at low population levels with the smaller *P. reticulata*, but the larger *G. affinis* and *Oreochromis* prevent the daytime appearance of hypogeal shrimp due to predation.

The average salinity in Kealakehe pools is relatively high at 13.5 ppt compared to most other pools along the West Hawai‘i coastline, having an average of approximately 7 ppt. This high salinity appears to be characteristic of this region, and is similar to the average of most pools within the adjacent ahupua’a of Honokōhau and Kaloko. The levels of nitrate-nitrogen levels are relatively high compared to other undeveloped areas, but fall in the range of some developed landscapes. Other water quality parameters, including pH and temperature, fall into normal ranges for anchialine pools.

This relatively high salinity is the likely reason aquatic insects were not found in any pools at Kealakehe. Though the rare damselfly *Megalagrion xanthomelas* has been observed and collected from Kaloko, a statewide assessment of its range has not found it to occur in water with salinity greater than 3ppt. However, there has been an unsubstantiated occurrence of the nymph in a pool of up to 8ppt (Polhemus, 1995).

Another species of concern is the hypogeal decapod shrimp *Metabetaeus lohena.* These shrimp are sometimes predatory on *H. rubra* but are more often opportunistic omnivores similar to *H. rubra.* Predusk and nocturnal sampling at high tide is clearly the optimal method to determine habitat range and population densities for this species. These shrimp were found in 13 of the 19 pools, 7 of which had *M. lohena* only at night. The occurrences of *H. rubra* were found in 16 of 19 sampled pools, 8 of which had ‘Ōpae‘ula observed only at night. Consequently, despite having numerous degraded anchialine resources at Kealakehe, there are opportunities for many of the pools to be restored and enhanced to a level where large populations of anchialine shrimp and other native species may return to inhabit the pools as they likely have in the past.

~~As mentioned earlier, the southern ponds also had elevated concentrations of nutrients indicating water quality degradation. These factors indicate that if no restoration or maintenance activities are instituted to reserve these ponds, these ecosystems will degrade beyond recovery.~~

~~3.9.3.2~~3.9.2.2 Anticipated Impacts and ~~Recommended~~ Proposed Mitigations

The anchialine ~~ponds~~ pools that are located north of the existing harbor are not likely to be impacted because no development activities are proposed north of the existing harbor. It is highly unlikely that existing groundwater flows to the Kaloko-Honokōhau pond system to the north of the existing harbor will be impacted by the proposed marina to the south.

Of the 19 pools in the southern complex, three would be eliminated due to harbor construction. Regarding the remaining pools, the DEIS noted that t~~T~~he change in the local groundwater flow pattern in the vicinity of the proposed marina ~~will~~ would impact the anchialine ~~ponds~~ pools that are located between the proposed marina and the shoreline south of the harbor entrance. The 2006 study (Appendix H-1) noted that t~~T~~he salinity of the anchialine ~~ponds~~ pools ~~will~~ would increase due to reduction of brackish groundwater, and that ~~. Some ponds will be excavated to make the new harbor basin. T~~those ~~ponds~~ pools that are not excavated will revert to full salinity, causing the loss of their habitat. ~~and associated aquatic flora and fauna. However, current investigations indicate that these ponds are already enriched by nutrients and the density of associated aquatic fauna is very low. In addition, trash from visitors, and introduction of minnows has already degraded the pond ecology.~~ Even without the potential impacts from the proposed marina construction, the pond ecology might change irreversibly from the nutrient input, human indifference and expansion of non native fauna species.

Further studies conducted in response to DEIS comments (Appendix H-2, and Appendix G-3) indicate that the remaining pools may not increase in salinity to levels unhealthy for *H. rubra* and *M. lohena* and other anchialine pool fauna. In addition, these studies determined that there are realistic mechanisms employed elsewhere that would mitigate changes due to groundwater changes. Waimea Water Services found that harbor construction would cut off some of the fresher ground-water flow. However, predicting the extent of change in flow is difficult if not impossible even with numerous boreholes and intense sampling. The actual flow of groundwater towards the sea is minimal today, and tidal measurements show that tide fluctuations represent more than 90 percent in actual harbor tides. The fluctuations occur simultaneous with the ocean/harbor tide, which indicate a vertical and horizontal pressure regime between bore hole 6 and the ocean and harbor. Hence, the tides alone create a mixing system that increases salinity, as the flow approaches the point of discharge which will be either the channel or the shore.

Another factor that could influence groundwater quality is the increased local recharge from irrigation between the channel and shore. This will add fresh water to the lens locally but is not quantified at this time.

Quantification of these impacts, including the flow of groundwater through each pond, is extremely difficult. The shallow lavas are of the pahoehoe type and have a relatively high horizontal permeability. In surface depressions or undulations, the pahoehoe lavas have a tendency to lose vertical permeability from sedimentation thus restricting water exchange within the individual pools. This is normally reflected in both the salinity and temperature and this information has been adequately studied in the pools.

Changes in groundwater quality may or may not impact biological communities in the anchialine and estuarine environment. In either case, it is important to understand these relationships to effectively manage the resource. If there is significant deviation from the baseline especially in regard to nutrients, pathogens, and toxins, a mitigation plan to determine the cause and take decisive appropriate action will be implemented. The mitigation plan will be based on the following objectives:

Objective 1 To preserve, maintain, and foster the long-term health and native ecological integrity of anchialine pools at Kealakehe.

Objective 2 To protect and promote cultural practices and traditions surrounding anchialine resources at Kealakehe.

Objective 3 To provide education, interpretation, and interactive opportunities for the community to learn about and appreciate the anchialine resources.

Objective 4 To acquire a pond manager to implement the program, conduct monitoring, research, and reporting, and provide education to the community about anchialine and estuarine resources.

Mitigation measures to facilitate the long-term health of the remaining anchialine pools will be based on environmental monitoring, which is vital as an early warning system to detect potential environmental degradation. A series of quantitative baseline analysis of the physio-chemical and biological components within the project site will provide a standard by which the effects of the development, anthropogenic activities, and natural phenomena on the environment can be measured. The framework for the mitigation plan will include three measures intended to meet these objectives, including bioretention, salinity adjustment and possible new pools.

As a mitigation measure, bioretention, which is a Best Management Practice (BMP) is a feasible application for the proposed development. There is a probability that nutrients and other potential pollutants will runoff landscaping and impermeable surfaces such as roadways and parking lots during medium or high rainfall events. Some of these pollutants could enter the groundwater table and into anchialine pools and ultimately the ocean. As an alternative to directing runoff into the ground through drywells, storm water should be directed into bioretention areas such as constructed surface or subsurface wetlands, vegetated filter strips, grass swales, and planted buffer areas. Storm water held and moved through these living filter systems are essentially stripped of most potential pollutants, and allowed to slowly infiltrate back to the groundwater table.

Bioretention is a Best Management Practice (BMP) that would be a highly appropriate application for the proposed development. Further, BMPs utilized in series may incorporate several storm water treatment mechanisms in a sequence to enhance the treatment of runoff. By combining structural and/or nonstructural treatment methods in series rather than singularly, raises the level and reliability of pollutant removal. Another means to reduce the potential for groundwater contamination is to increase soil depth above the standard in landscaped areas. This will allow chemicals to be held in the soils longer for more complete plant uptake and breakdown of these chemicals by soil microbes. A specific guide for chemical application by landscape maintenance personnel will be a beneficial tool to help avoid contamination of groundwater resources.

Another mitigation measure that may be included in the management plan is salinity adjustment. In the 2006 assessment regarding the impact to the southern pools from the proposed construction of the harbor, it was stated that this construction would cause the salinity in the anchialine pools to become equivalent to the ocean at 35ppt. It was then concluded that the anchialine biology would perish.

However, there is currently a level of uncertainty by professional hydrologists as to the exact movement of surface groundwater and a final determination of anchialine salinity following the harbor construction. The dynamics of groundwater movement through a porous lava medium both seaward and laterally along the coastline is an inexact science. This is compounded by the variations in water density, including stratification of salinity within the proposed harbor and capillary movement of low-density surface water through the substrata.

The assessment that all anchialine pools will be barren with the construction of the harbor may therefore be premature. *H. rubra* are routinely drawn from high salinity wells at 30 – 32 ppt and survive in this salinity for years. Further, high populations *H. rubra* and *M. lohena* have thrived and reproduced in pool salinities of 27ppt. If the pools do become full strength seawater at 35ppt, there exists uncertainty on the long-term effects to anchialine organisms, since there are no long-term studies or examples of native anchialine ecosystems at 35ppt. Native anchialine pool vegetation also has relatively high salinity tolerance.

If the salinity were expected to rise to 35 ppt, possible mitigation in the management plan will include methods to surcharge man-made anchialine pools created adjacent to or in the vicinity of natural pools with low salinity well water. If sufficient volume is used, it is theoretically possible to lower salinity in adjacent natural anchialine pools. This surcharge method has been successfully used to raise salinity in anchialine pools and cause the salinity rise in adjacent pools of at least up to 10 meters away. Surcharging with low salinity should work as well or better since the lower density water will essentially float atop the higher salinity water at the surface layer, and move throughout the complex of natural pools. Surcharging may also be a viable mitigation to dilute and more rapidly disperse any pollutants that may be detected in the pools.

Another mitigation measure includes the creation of new anchialine pools. There is significant opportunity to create new anchialine pools and greatly expand the native habitat and resource. It has been demonstrated at several projects in West Hawai'i that anchialine pools can be created and will be colonized with a full compliment of anchialine species endemic to the area. Anchialine pools are considered focal points of higher productivity relative to the subterranean groundwater habitat around them. Their productivity promotes an increase in population levels of anchialine species within the pools themselves and throughout the subterranean habitat surrounding them.

~~No realistic mechanisms are envisioned for re-injecting fresh water into these systems to maintain their ecological balance as an anchialine system. These ponds will be changed from a brackish water system to a marine system. But, those ponds in the area of the shoreline park and cultural park will be cleaned of vegetation and protected from other physical alteration. A buffer zone around these newly established marine ponds will be protected as well.~~

~~The anchialine pond shrimp (*Metabetaeus lohena)* and the orangeback damsel fly (*Megalagrion xanthomelas)* are listed as candidate endangered species in the Federal Register and were both recorded in surveys of these anchialine ponds done in 2004 by US Geological Survey Biological Resources Division and the NPS Inventory and Monitoring Program. Low numbers of *Metabetaeus lohena* were encountered in three of the 22 ponds surveyed in the southern pond complex. *Megalagrion xanthomelas* was not encountered in any of the southern pond complex ponds during the recent study. The low density of *Metabetaeus lohena* and the observed absence of *Megalagrion xanthomelas* may be due to the impacts from high nutrient input and general degradation of the ponds.~~

~~An attempt should be made to move as much of the existing population of *Metabetaeus lohena* from these anchialine ponds before they become too saline, to possible newly excavated ponds that may be developed off-site. These shrimp should not be introduced into existing populated ponds to avoid any potential pathogenic impacts to the healthy ponds.~~

~~Public education on the unique ecology of the anchialine ponds and the need for preserving their ecology will reduce future human impacts in other healthy ponds.~~

~~Further recommended mitigation includes restoration to degraded anchialine ponds off the project site, preferably those located at the adjacent Kaloko-Honokōhau National Historical Park.~~

Attachment 3

The increased level of fisheries knowledge has spawned an atmosphere of stewardship in the general charter-boat fishing community. With catch and release programs returning upwards of 40 percent of the Kona catch back to the ocean there is an obvious awareness that the value of catching the fish is often far greater than the value of selling it. It is ~~recommended~~ proposed that facilities and programs to foster continued stewardship, fisheries science, tracking of all fish catch, and educational programs be implemented in the design of the new marina facilities.

The proposed marina, marina support facilities, public marina promenade, fishing club, and marine science center will provide a venue for implementing the following efforts:

- Efforts to promote tag and release will be fostered through public education and the implementation of more "Catch and Release – Only" tournaments.
- Promote management through catch limits to possibly include slot weight catch limits, ~~ie.~~i.e. must tag & release animals between 250–950 pounds
- Promote various other stewardship measures relating to fisheries conservation.

~~3.9.5~~3.9.4 Marine Mammals and Sea Turtles

In addition to water quality, which is discussed in Section 3.9.1.3, other environmental impacts that may affect marine mammals and sea turtles include noise and vessel collisions. The following sections describe existing conditions, potential impacts and suggested mitigations to prevent negative impacts to marine mammals and sea turtles from noise and vessel collisions.

~~3.9.5.1~~3.9.4.1 ~~Existing Conditions~~Affected Environment

A number of marine mammal and turtle species are found in Hawaiian waters near the Kona Kai Ola project site. Detailed information on the abundance, behavior, threats to the species, hearing ability and vocalization data is provided for all species in Appendix S. Data on the most prevalent endangered species and species of particular interest are summarized here.

Humpback Whales: The population of h~~H~~umpback whales (*Megaptera novaeangliae*) around Hawai‘i was estimated to be between ~~are mammals and belong to the baleen whale suborder, *mysticeti*. An estimated~~ 4,500-6,500 in 2000 ~~whales migrate between subpolar Alaska and Hawai‘i each year~~ (Mobley et al 2001). The population growth rate between 1993 and 2000 is estimated to be seven percent indicating that the population is recovering from its dramatic reduction due to commercial whaling. It is worth noting that this is considered a high rate of increase for a mammalian species.

The highest densities of animals are found within the 100 fathom isobath. ~~and seek refuge in shallow waters close to shore.~~ Most humpbacks off Hawai‘i are found north of Honokōhau in the waters of the Hawaiian Islands Humpback Whale National Marine Sanctuary. Nevertheless, they are commonly seen off Honokōhau in winter months. Humpbacks are not deep diving animals. Whales in Hawai‘i typically dive to less than 100 feet, although occasional deeper dives are possible (Hamilton et al. 1997)The whales breed and give birth while in Hawai‘i during the winter months, and migrate north to feed each spring.

~~Humpback whales found in Hawai‘i's waters are part of a global population of Humpback whales that was reduced by over 250,000 individuals, or 90 percent, due to hunting (Johnson et al 1984). In 1966, the International Whaling Commission instituted a moratorium on all hunting of whales globally, and populations have begun to rebound. The North Pacific population of humpback whales, with a population of approximately 15,000 prior to hunting, is recovering from an estimated low of 1,000 individuals (Rice 1978, Johnson et al 1984). Humpback whales are also protected under the Federal Endangered Species Act. It is estimated that Hawai‘i's population of Humpback whales is growing by 7% annually (Mobley et al 2001).~~

Congress designated the Hawaiian Islands Humpback Whale National Marine Sanctuary (HINMS) on November 4, 1992, and was followed by the Governor of Hawai‘i's formal approval in 1997. The Sanctuary's purpose includes protecting humpback whales and their habitat within the Sanctuary, educating the public about the relationship of humpback whales to the Hawaiian Islands marine environment, managing the human uses of the Sanctuary, and providing for the identification of marine resources and ecosystems of national significance for possible inclusion in the Sanctuary. The sanctuary is approximately four nautical miles north of Honokōhau Harbor.

~~While waters surrounding the main Hawaiian islands constitute one of the world's most important North Pacific humpback whale habitats (Calambokidis et al. 1997), the Sanctuary actually encompasses five noncontiguous marine protected areas across the Main Hawaiian Islands, totaling 1370 square miles. Almost half of this area surrounds the islands of Maui, Lāna‘i and Moloka‘i. Smaller areas are designated on the North shore of Kaua‘i, North and Southeast shores of O‘ahu, and Hawai‘i's Kona Coast. On Hawai‘i's Kona Coast, the Sanctuary encompasses the entire northwest-facing coast, consisting of submerged lands and waters seaward of the shoreline to the 100-fathom (183 meter) isobath from ‘Upolu Point southward to Keāhole Point, which is approximately four nautical miles north of Honokōhau Harbor.~~

Whales have very sensitive hearing, so any loud underwater sound has ~~may have~~ the potential to disturb these animals. ~~Vessel collisions are also a concern with whales.~~ Playback experiments have estimated that humpback whales will respond to biologically meaningful sound at levels as low as 102 dB re 1 µPa, a level that is similar to background ambient noise (Frankel et al. 1995). Increases in vessel numbers will lead to an increase in noise from operating boats. However, even at its greatest predicted increase, the median sound level from active boats is not expected to raise sound levels to an intensity that would be considered an impact (Level B take) to marine mammal population (See Appendices T-2 and T-3). Humpback whale song ranges from 20 Hz to over 10,000 Hz, with most acoustic energy typically concentrated in the 100-1000 Hz range. This vocal production and the anatomy of their inner ear indicate that these animals are most sensitive to low-frequency sound (Ketten 1992).

Numerous studies have shown that human activity can affect humpback whale behavior, including vessel activity (Bauer 1986; Norris 1994; Corkeron 1995; McCauley et al. 1996; Scheidat et al. 2004), oceanographic research (Frankel and Clark 2000; Frankel and Clark 2002), and sonar (Miller et al. 2000; Fristrup et al. 2003). If the humpback whale population continues to expand at its present rate (8%/year) it can be expected that greater numbers of whales will extend into waters off the Kona Coast. This is likely to increase the demand for whale watching vessels from the new harbor and this increase will have a negative impact on the whale population expansion. The increase in both the number of vessels and number of whales increases the chance for collisions.

Vessel collisions are also a major concern. The majority of whale strikes occur~~red~~ where whales and boats are most common, such as in ~~and boats watching are common as in~~ shallow waters between Lāna‘i and Maui. In a recent study, three of ~~conducted by NMFS on~~ 22 ~~27~~ recorded whale-vessel collisions ~~strikes~~ in the main Hawaiian Islands ~~, only two were recorded~~ occurred off the Kona coast. (Lammers et al. 2003). That study also found that 14 of the 22 collisions were reported between 1995 and 2003. This observed increase may result from more awareness of the issue, or from the greater number of both whales and vessels in Hawaiian waters. In Hawai‘i, data from 1972 to 1996 reveal at least six entanglements of humpback whales in commercial fishing equipment (Mazzuca et al. 1998). These data also indicate an increasing trend of entanglement since 1992 and a three-fold increase in death and entanglement occurrences related to human activity in 1996.

It is highly unlikely that humpback whales will approach to within the Level A or Level B impact “take” zones created by the explosive blasts of harbor construction. However, the sounds generated by these explosions will be within the frequency hearing range of humpback whales and could potentially be heard by whales between Kona and Maui. Modeling predicts that the maximum sound level two miles offshore the site is less than 150 dB re1 µPa, which is less than the threshold for Level B impacts. As the explosions are planned to occur daily for up to 9 months, the cumulative impact of this noise must be considered if construction is anticipated when whales are expected in the area (December 15 – March 30).~~In one instance, a fishing boat was pulling in a catch and was lifted by a whale. In the other instance, a whale was struck by a dive boat heading towards its diving spot.~~

Dolphins: A number of dolphin species are found in the waters near Honokōhau Harbor. Detailed information on all of these can be found in Appendix S. Spinner dolphins (*Stenella longirostris*) are regularly seen in shallow water and in close proximity to the project site. ~~Spinner dolphins (*Stenella longirostris*), often inhabit waters within Honokōhau Bay and at times intentionally congregate near the harbor channel to take advantage by bow-riding outgoing vessels. "Spinners" common name stems from their habit of leaping clear of the water and twirling in the air.~~ They are the smallest dolphins typically seen in Hawai‘i, with a mature size of 6 feet in length and 160 pounds.

Spinners school in pods of a few animals to ~~100~~ 180 or more, with pod sizes of 1-20 being most common (Östman-Lind et al. 2004). They ~~and show community behavior when~~ feed~~ing in~~ on mesopelagic fish, squid and shrimp in deep water at night, and rest in nearshore shallow waters during the day (Norris and Dohl 1980; Benoit-Bird et al. 2001). ~~when they come near shore to play and rest. On the Island of Hawai‘i, Kealakekua Bay is one location of almost daily spinner visits, but they frequent many other bays along the coast and regularly rest in Honokōhau Bay.~~ There are seven primary resting areas along the Kona coast of Hawai‘i, including Honokōhau Bay, where spinners are regularly seen near the harbor entrance (Östman-Lind et al. 2004). There is some evidence that the spinner dolphins may be resident to the area (Östman-Lind et al. 2004), making them more susceptible to repeated disturbance.

The hearing ability of spinner dolphins has not been measured. However, hearing of the related striped dolphin (*Stenella coeruleoalba*) was measured between 500 Hz and 160 kHz, with maximum sensitivity at 64 kHz (Kastelein et al. 2003). The hearing response of this single dolphin was less sensitive below 32 kHz than other dolphins. ~~As all marine mammals have very sensitive hearing, any loud underwater sounds have the potential to disturb dolphins as well. Given the sporting habit of spinners and other dolphins of bow-riding ships and small boat wakes, they are apparently not overtly impacted by vessel traffic noises.~~

Despite their limited sensitivity to low frequency sound, spinner dolphins have been shown to be impacted by human activity. Examples include interruption of resting activity and increases in the number of higher energy behaviors (Luna-Valiente and Bazúa-Durán 2006). Numerous studies describe changes in distribution (Haviland-Howell et al. in press) and short-term behavioral changes of dolphins in response to vessel traffic (Bejder et al. 1999; Scarpaci et al. 2000; Gregory and Rowden 2001; Nowacek et al. 2001; Van Parijs and Corkeron 2001; Ritter 2002; Lusseau 2003; Ng and Leung 2003). However, it has been established that for at least one population of bottlenose dolphins, these repeated short-term effects translate into long-term detrimental effects on the affected population (Bejder et al. 2006a; Bejder et al. 2006b).

In Hawai‘i, some entanglements of spinner dolphins have been observed (Nitta and Henderson 1993; Rickards et al. 2001) but no estimate of annual human-caused mortality and serious injury is available. A habitat issue of increasing concern is the potential effect of swim-with-dolphin programs and other tourism activities focused on spinner dolphins around the main Hawaiian Islands (Östman-Lind et al. 2004).

Hawaiian Monk Seals: Endangered Hawaiian Monk Seals (*Monachus schauinslandi*, Hawaiian Name: ‘Ilio holo I ka uaua)~~ are on the endangered species list~~ . ~~They~~ are rare, but not unknown along the Kona Coast. ~~Fortunately, monk seals are air breathing and spend the majority of their time above water where they are easily observed. If a monk seal is reported observed in the area, Kona Kai Ola would work with relevant agencies to protect the seal.~~ Most monk seals are found in the Northwest Hawaiian Islands, but recent aerial surveys estimated that there are 52 seals in the main Hawaiian Islands (Baker and Johanos 2004). There have been 13 sightings between 2003 and 2006 in the vicinity of Kaloko-Honokōhau National Historical Park (NOAA protected species division data) indicating regular, albeit low-level use of these areas by monk seals. ~~One~~Two birth on the Island of Hawai‘i have~~s~~ been reported (Baker and Johanos 2004).

The best population estimates for Hawaiian monk seals (as of 2003) was 1,244 (Carretta et al. 2004). However the population is currently showing a decline that has been continuing since the 1950s (Antonelis et al. 2006).

Underwater hearing in the Hawaiian monk seal has been measured between 300 Hz to 40 kHz. Their most sensitive hearing is at 12 to 28 kHz, which is a narrower range compared to other phocids. Above 30 kHz, their hearing sensitivity drops markedly (Thomas et al. 1990).

Monk seals are very intolerant of human activity and are easily disturbed. When the U.S. military inhabited Sand Island and the Midway Islands and Kure Atoll, the monk seals disappeared until after the military left. Monk seals prefer to be solitary animals (Reeves et al., 2002).

Sea Turtles: Five species of sea turtles are known to frequent Hawaiian waters, with Hawaiian green sea turtles (*Chelonia mydas*) by far the most abundant at 97% of the total numbers, hawksbill turtles (*Eretmochelys imbricata*, 1.7% of total), olive ridley turtles (*Lepidochelys olivacea*, 0.8%), and occasional sightings of leatherback (*Dermochelys coriacea*) and loggerhead sea turtles (*Caretta caretta*, Chaloupka, et al, 2006, from stranding reports). Green sea turtles are the most plentiful large marine herbivore in the world and have experienced a very successful population recovery in Hawaiian waters since 1974 when harvest was outlawed in Hawai‘~~iH~~i, and 1978 when they became protected under the Endangered Species Act (Balazs, et al. 2004). Both green sea turtles and hawksbills are known to breed and nest on beaches within the main Hawaiian Islands, and have a 25-30 year generation time with a life span of 60-70 years (Balazs et al 2004). Total population numbers of green sea turtles in the Hawaiian archipelago have not been estimated, but the population has at least tripled since the 1970s and may now be approaching the carrying capacity of the islands (Chaloupka, et al. 2006).

Bartol et al. (1999) measured the hearing of juvenile loggerhead sea turtles using auditory evoked potentials to low-frequency tone bursts found the range of hearing to be from at least 250 to 750 Hz. The frequency range that was presented to the turtles was from 250 Hz to 1000 Hz (Bartol et al. 1999).

Most recently, Bartol and Ketten (2006) used auditory evoked potentials to determine the hearing capabilities of subadult green sea turtles and juvenile Kemp’s ridleys. Subadult Hawaiian green sea turtles detected frequencies between 100 and 500 Hz, with their most sensitive hearing between 200 and 400 Hz. However, two juvenile green turtles tested in Maryland had a slightly expanded range of hearing when compared to the subadult greens tested in Hawai‘i. These juveniles responded to sounds ranging from 100 to 800 Hz, with their most sensitive hearing range from 600 to 700 Hz. The two juvenile Kemp’s ridleys had a more restricted range (100 to 500 Hz) with their most sensitive hearing falling between 100 and 200 Hz (Bartol and Ketten 2006).

Adult ~~G~~green turtles are primarily herbivorous often seen on reefs as deep as 100+ feet but much more common in shallower waters. Foraging behavior of green turtles is well documented and in Hawai‘i is typically characterized by numerous short dives (4 to 8 min) in shallow water (typically less than 3 m) with short surface intervals (less than 5 sec) (Rice et al. 1999).Resting periods are characterized by longer dives (over 20 min) in deeper water (4 to 40 m) with surface intervals averaging 2.8 min (Rice et al. 1999). The amount of time that turtles spend foraging versus resting is still largely unknown. Green turtles in Hawai‘i frequently use small caves and crevices in the sides of reefs as resting areas, and spend significant amounts of time on the tops of reefs (Balazs et al. 1987). Green turtles are known to be resident in Kiholo Bay, Hawai‘i (Balazs et al. 2000), and presumably other areas as well, potentially increasing their susceptibility to vessel collision and/or repeated disturbance. Two turtle “cleaning stations” have been reported near the mouth of Honokōhau Harbor. ~~During periods of calm water green sea turtles are often seen over very shallow reef flats where the choicest of algae are to be found. While some turtles may "rest" upon the surface, it is much more common to find them in small caves or wedged between coral heads where they are less subject to shark attacks. Green sea turtles may occasionally be seen far at sea (they nest in French Frigate Shoals in the NW Hawaiian Islands), but they are much more prevalent over the shallow shoreline areas where they forage for food.~~

Vessel collisions and potential noise impacts are a concern with regard to turtles. In a study of 3,861 turtle strandings in the main Hawaiian Islands from 1982 – 2003 (Chaloupka, et al. 2006), boat strikes accounted for only about 2.7 percent of the cases and were almost always fatal (95 percent). Entanglement in gill nets accounted for about six percent of strandings and also had a high rate of mortality (75 perce~~d~~nt). Hook and line entanglement (seven percent of strandings) was much less likely to result in the death of the turtle (52 percent mortality). At least 20 green sea turtles have stranded in Honokōhau Harbor or along the boundaries of Kaloko- Honokōhau National Historical Park. ~~Of all 3,861 strandings recorded in the Main Hawaiian Islands since 1982 only three occurred within 10 miles north or south of Honokōhau Harbor (Balazs, personal communication from NMFS database).~~

Recent increases in longline fisheries may be a serious source of mortality. Greens comprised 14% of the annual observed take of all species of turtles by the Hawai‘i-based longline fishery between 1990 to 1994 (NMFS 1998a). Over the period of 1994 to 1999, it was estimated that an annual average of 40 green sea turtles were caught by the Hawai‘i-based longline fishery (McCracken 2000).

Recent proliferation of a tumorous disease known as fibropapillomatosis (Herbst 1994) may reverse improvements in the status of the Hawaiian stock (NMFS 1998a), although recent modeling suggests that population levels continue to increase despite the disease (Chaloupka and Balazs 2005). The disease is characterized by grayish tumors of various sizes, particularly in the axial regions of the flippers and around the eyes. This debilitating condition can be fatal and neither a cause nor a cure has been identified.

Hawksbill turtles (Eretmochelys imbricate) are observed less often than green sea turtles near Honokōhau. About 20-30 female hawksbills nest annually in the Main Hawaiian Islands (NMFS 1998b). In 20 years of netting and hand-capturing turtles at numerous nearshore sites in Hawaiʻi, only eight hawksbills (all immatures) have been encountered at capture sites including Kiholo Bay and Kaʻu (Hawaiʻi), Paloʻou (Molokaʻi) and Makaha (Oʻahu) (NMFS 1998b). It was only recently discovered that hawksbills appear to be specialist sponge carnivores (Meylan 1988). Previously they had been classified as opportunistic feeders on a wide variety of marine invertebrates and algae.

Increasing human populations and the concurrent destruction of habitat are also a major concern for the Pacific hawksbill populations (NMFS 1998b). Hawksbill turtles appear to be rarely caught in pelagic fisheries (McCracken, 2000). However, incidental catches of hawksbill turtles in Hawaiʻi do occur, primarily in nearshore gillnets (NMFS 1998b). The primary threats to hawksbills in Hawaiʻi are increased human presence, beach erosion and nest predation (*e.g.*, by mongooses) (NMFS 1998b).

~~3.9.5.2~~3.9.4.2 Anticipated Impacts and ~~Recommended~~ Proposed Mitigation

A complete analysis of the in-air and in-water potential acoustic impacts from the construction of the Kona Kai Ola small boat harbor was completed by Marine Acoustics, Inc.(MAI) and is included in this document as Appendix T-3. In conducting this analysis, the best available scientific, environmental, geologic, and meteorological data were obtained and used to calculate the acoustic transmission loss (TL) and subsequently to predict the received levels (RLs) at the five receiver sites. State of the art acoustic propagation models were employed in this analysis to determine in-air and in-water TL. MAI used the Acoustic Integration Model© (AIM©) to assess the impact of the predicted acoustic sound field on the species of marine mammals that could conceivably occur near the Kona Kai Ola project site.

The conclusion of that report determined that the criteria for Level A impacts to marine mammals for either in-air or in-water conditions at the receiver sites were never exceeded for the model source and receiver locations for non-blasting activities. However, these thresholds could be exceeded by the explosive blasting used to create the new harbor. For both in-air or in-water acoustic propagation, this only occurred when an animal was within about 200 meters (656 ft) of the explosion, This condition could only occur when the explosive source was at locations farthest north in the new harbor and closest to the existing harbor. This condition mandates that a safety range out to at least 200 meters (656 ft) of the source be shown to be clear of all marine mammals and sea turtle prior to each blast to preclude potential Level A takes.

The MAI report indicated that the in-air RLs for the explosive sources would exceed the assumed 100 dBA threshold for Level B harassment of pinnipeds (seals) for ranges out to about 0.4 nm (i.e., 800 yds [731 m]). This threshold is nominally for pinnipeds, but it should be extended to surface resting marine mammals and basking or beached sea turtles. Therefore, an in-air safety buffer of at least 731m from any explosive source is proposed, that should be maintained and found clear of marine mammals and basking or beached sea turtles prior to any blasts. It should be noted that although a receiver site was not modeled specifically in the existing harbor, that area is often within the range of this safety buffer and that extra care should be taken to ensure that no marine mammals or sea turtle are in the existing harbor prior to any blast. Analysis of the most restrictive Level B in-water explosive threshold shows that it is only exceeded when an animal is closer than 300 m (984 ft) from the explosive source.

Although the possibility exists for Level B impacts to marine mammals, based purely on the sound fields produced by the explosive blasts, analysis is the marine mammal distribution and movement as predicted by the AIM model, indicates that this is very unlikely situation. Therefore, it is expected that there will be much less than 0.5 Level B takes, with or without mitigation. But the mitigation safety buffer must still be enforced to preclude the unlikely possibility of marine mammals or sea turtle being near the explosive sources when they are used.

It should be recognized that several mitigation measures are already built into the proposed project. For example, the proposed practice to maintain a rock "dam" separating the construction site from the existing harbor reduces acoustic energy propagating to area potentially containing marine mammals or sea turtles. Also, this dam precludes animals from entering the construction area. This dam or land-bridge will be in place for all drilling and dredging activities, except for the removal of the land bridge itself.

Several other possible methods of mitigation are available to the Kona Kai Ola project, and feasibility, practicality, and benefit will be discussed with the National Marine Fisheries Service (NMFS) during consultation, and may be implemented subsequent to that consultation. The first possible mitigation technique is to acoustically monitor the potentially impacted areas during construction to: a) assess the accuracy of the modeling and b) to interact proactively with construction personnel to ensure that the identified threshold levels are not exceeded. Although the best available science and data was used to model the acoustics of the area, numerous conservative assumptions needed to be built into the modeling. By monitoring the actual levels received, in-situ corrections/updates to modeled parameters could potentially reduce the built--in conservativeness and reduce the potentially impacted areas. For example, the modeling assumes that all of the small voids in the bedrock are water-filled and therefore impart minimum attenuation on the acoustic signal as it propagates through. If even a small percentage of the voids are gas-filled, this attenuation would increase greatly and the impacted area would be reduced.

Another possible mitigation technique would be to augment the land-based visual observer, who it is assumed would verify that the area was clear the animals, with boat-based observers. This would increase the effectiveness of recognizing the presence of marine mammals and sea turtles in the potentially affected areas.

Additionally, interactions with the construction teams to alter the blasting methods modeled could potentially mitigate and reduce acoustic impacts to marine animals. A blasting expert will be consulted to develop a discontinuous non-linear blasting plan that will optimize cancellation of the explosion pressure wave into the marine environment. Examples of possible changes include: reducing charge size, reducing the depth drilled and blasted during any blast, reducing the number of blast holes or the volume of each blast, etc. The combination of these techniques with acoustic monitoring could potentially allow a large portion of the northern third of the harbor to be excavated with little or no potential impact to marine animals.

Interactions with NMFS during the consultation period will be used to examine these or any other techniques which may be identified. Also, the project is requesting help in identifying any possible method known to NMFS to establish and maintain turtle exclusion areas, especially in the existing harbor, without harassing the turtles. It may become apparent during those consultations that even with the identified buffer zones and mitigation techniques that an Incidental Harassment Authorization (IHA) is required, especially for the northern third of the proposed harbor.

Marine Acoustics, Inc. also completed a study of the expected ambient noise levels in Honokōhau Bay as a result of the increased vessel traffic from the expanded harbor. This report is included in this document as Appendix T-2. That report concluded that the average maximum daytime ambient noise levels would be expected to increase about 9.7 dB across the frequency spectrum from 100 Hz – 2 kHz, with the quadrupling of the vessels using the expanded harbor (i.e., the proposed action). Although significant, this increase would occur primarily during daylight hours, and the predicted median ambient noise would still be below 100 dB for all frequencies. The other significant factor is that there will be a quadrupling of the number of localized (i.e., small) individual sound fields in the area. These sound fields surround the individual boat that are contributing to the overall ambient noise. Noise levels in excess of 120 dB extend out to about 550 m (1804 ft) from these boats, with even high levels at closer ranges. Short of actual collisions with animals, Level A impacts are unlikely for noise levels typically generated by small boats. The Level B threshold nominally extends to approximately ten meters around each boat (depending on equipment such as size of motor, conditions of propeller and other equipment). Therefore potential Level B impacts to marine mammals and sea turtles would only occur within this range. Therefore, the chance for potential Level B impacts is small.

Completion of the harbor expansion project will increase the vessel traffic crossing the Hawaiian Islands Humpback Whale National Marine Sanctuary, the southern boundary of which is approximately four nautical miles north of Honokōhau Harbor. At a time when the whale population is growing, an increase of vessel traffic may increase the likelihood of vessel-whale collisions. Related to vessel traffic, an increase in whale watching activities is also likely. Vessels participating in these activities directly seek out higher whale population densities, increasing the likelihood of collisions, but also having the potential for disrupting whale behaviors such as resting, courting, mating or birthing.

As noted earlier, however, of the ~~27~~ 22 recorded whale strikes in the main Hawaiian Islands, only ~~two~~ three were recorded off the Kona coast. Sanctuary managers may need to implement additional regulations for private and/or commercial activities directly involving whale encounters. Mariner education programs, already in place as part of Sanctuary operations, will help to mitigate possible impacts due to increased boaters, and the proposed marine science center will complement Sanctuary educational programs.

~~Impacts to turtles may occur during construction of the marina. Since most of the marina will be excavated in a land-locked condition, turtles will not be subject to any potential harm from excavation. Experience during construction of the Ko Olina lagoons, and the expansion of the Barber’s Point Harbor on O‘ahu indicate that turtles abandoned their offshore (30-100 ft depth) resting habitats and concentrated in very near shore waters adjacent to the harbor and, at times, even within the active construction areas as soon as blasting and excavation began. Although no turtle injuries or mortalities were reported during either of those harbor construction activities, this should serve as a cautionary example for future coastal construction activities.~~

An increased level of impacts to turtles from increased boating and fishing activities may occur. ~~The level of impact documented by National Marine Fisheries Service is limited to only three turtle mortalities confirmed, since 1982, from a total of 3,861 strandings throughout the Main Hawaiian Islands~~. Of the 3,861 turtle strandings recorded from the Main Hawaiian Islands since 1982, 75% were mortalities, and of these about 4% (~est. 116, from Figure 3 of Chaloupka, et.al.) were from boat strikes and 3 of these occurred within 10 miles of Honokōhau Harbor. Data from NPS staff at the adjacent Kaloko-Honokōhau National Historical Park show a total of 20 strandings within the parking (19) and harbor (1) between 2000 and 2006 with one attributed to boat strike and 6 to fishing gear entanglement. Eleven additional gear entanglements and one additional boat strike were also recorded but not listed as strandings. Human caused impacts from fishing and boat strikes are anticipated to increase as turtle populations continue to increase and boating /fishing activities increase with the expanding harbor.

~~It would appear that anthropomorphic impact to turtles from boat strikes and fishing activities is very low along the Kona Coast adjacent to the existing harbor. It is likely that this is due in part to the relatively steep ocean bottom that limits the habitat of the turtles to the very nearshore areas away from the areas of heavy boat traffic~~. Recognition by the general public that sea turtles are protected ~~also~~ puts a heavy social pressure on fishermen who may inadvertently catch a sea turtle, and is likely a factor in the recovery of this species. Although no adverse impacts to turtles have been documented within the existing harbor, the close proximity of boats and turtles in this environment is cause for concern.

~~During land-based construction of the marina, no mitigation is necessary as previous experience has shown that turtles are not adversely impacted by these activities.~~ Once the land bridge is open, ~~however,~~ it is highly likely that turtles will be attracted into the new harbor and be subject to potential harm from in-water construction of piers or other facilities. During this period of time and until the harbor is operational, ~~it is recommended that a~~ mesh barrier will be ~~is~~ erected across the new harbor channel to exclude turtles from the inner basin. The mesh size needs to be selected in consultation with ~~regulatory~~ NMFS ~~agencies~~ to make sure it does not entangle turtles.

As the new harbor area will ~~likely~~possibly attract turtles to the basin (similar to the existing harbor) and an increase in boat traffic is expected in the harbor channel there will be an increased possibility of turtle strikes within the channel and new harbor area. To minimize this possibility it is ~~recommended~~ proposed that educational signs be erected around the harbor describing the turtles and warning boaters to be cautious while traversing harbor channels. The slow no-wake lane in the entrance channel should also be strictly enforced and the State should consider extending the slow no-wake zone further out to the first green buoy.

~~As all marine mammals have very sensitive hearing, any loud underwater sounds have the potential to disturb these creatures. Potential underwater acoustics may impact marine mammals and sea turtles during construction activities, such as blasting and pile driving. Appendix Q contains a study of underwater noise impacts during the construction and operation of the proposed project.~~

~~To mitigate impacts related to noise generated by construction activities, such as blasting and pile driving, a program to monitor sound levels and the presence of marine mammals and sea turtles will be implemented. Construction activities will be adjusted if whales, monk seals, dolphins or sea turtles are in the vicinity. Further, keeping the land bridge closed to the ocean until all major pile driving and blasting are completed will further avoid adverse impacts.~~

~~Increased boat traffic will result in increased low intensity sounds in the harbor area and along transit routes. The ecological role played by anthropomorphic sound in the marine environment has recently received heightened awareness. Evidence from declassified Department of Defense ocean recordings off of San Diego show that background sound levels off-shore of the harbor have increased approximately ten-fold in 30 years. Much of this increase in sound level has been ascribed to large ship traffic. While intense sound levels can adversely impact marine mammals and potentially other species, this level of sound pressure has not been shown to be produced by the small boats envisioned to occupy the new marina.~~

~~Adverse impacts of lower intensity noise, such as from small boat engines, have been very difficult to quantify. No definitive information is available to determine the level of impact produced by increase in small boat generated noise on fish, marine mammals and sea turtles. Given the sporting habit of spinners and other dolphins of bow-riding ships and small boat wakes, they are apparently not overtly impacted by vessel traffic noises.~~

~~However, boat-generated noises can be reduced by slowing boats to "slow no-wake" in the main traffic lane of the entrance channel. The State could also consider extending the "slow no-wake" lane out to the first green buoy. Appropriate signage to enforce these requirements is recommended.~~

~~3.9.6~~3.9.5 Ciguatera

Attachment 4

KONA KAI OLA MARINA
HARBOR WATER QUALITY STUDY

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June, 2007

APPENDICES

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1. INTRODUCTION

Jacoby Development, Inc. has selected Moffatt & Nichol (M&N) to develop and apply a numerical hydrodynamic and water quality model of the existing Honokohau Harbor and the proposed development. This new development, Kona Kai Ola, is an environmentally sustainable marina featuring a mix of uses including: visitor and resident-serving commercial enterprises, hotels and time-share units, marina services, and open space and community-benefiting facilities (such as public infrastructure improvements) in a pedestrian-friendly setting surrounding the marina and seawater lagoons. The proposed Kona Kai Ola Conceptual Master Plan includes a new 45-acre 800-slip marina that shares the entrance to the ocean with the existing Honokohau Harbor.

This report presents the development and calibration of a three-dimensional hydrodynamic and water quality numerical model of Honokohau Harbor, Kona Kai Ola and the surrounding coastal areas using a state-of-the-art numerical modeling system. Existing hydrodynamic and water quality conditions have been accurately reproduced with the numerical model, which indicated that the model can be used as a tool to predict the hydrodynamic and water quality conditions expected after construction in the new harbor system. A large number of future scenarios have been simulated with the numerical model in order to predict changes in water quality conditions after construction of the development. The model was also used to identify possible modifications to the conceptual master plan for the marina that could lead to acceptable water quality conditions of the new marina system.

2. WATER QUALITY AT HONOKOHAU HARBOR (1975-2006)

The historical data for specific water quality and hydrologic parameters for the Honokohau Harbor near the Kaloko-Honokohau National Historical Park, Hawaii are presented concisely in the following sections. The Harbor was built in 1970 and expanded in the late 1970's. Monitoring had been on-going for five years following the completion of the initial construction (1970-1975). The monitoring was performed with the purpose of investigating the resulting water quality conditions in addition to examining the colonization and ecological development within the Harbor. Because of the isolation of the Harbor from developments (absence of National Pollutant Discharge Elimination System-permitted dischargers (point source) and river/stream runoff (nonpoint source) within two miles of the Harbor), the Harbor provided a unique opportunity to "delineate valuable ecological cycles and describe important phenomena that may influence…coastal developments of this sort" (Bienfang, 1980). In short, baseline conditions were monitored and documented for future reference. Subsequent to these conditions, more recent studies have indicated that the Harbor's water quality has apparently improved since the post-construction survey. This conclusion is based upon increased dissolved Oxygen (DO)[1] for the temperature/salinity regime. Several benchmark parameters were used in this assessment to evaluate the DO improvements: ortho-phosphate (o-P)[2], nitrate-nitrogen (NO_3-N), ammonium-nitrogen (NH_4-N), Chlorophyll a (CHLa) and reactive Silica (Si).

The information collected and compiled by Bienfang (1980) and Bienfang and Johnson (1980) provide baseline information that will enable the State and other agencies to distinguish between background (pre-1980) and future man-made loadings/impacts. It is important to note that the studies (Bienfang, 1980 and Bienfang and Johnson, 1980) do not provide insight as to undisturbed conditions, as the harbor is a man-made entity in and of itself. These conditions only represent baselines in the sense that they describe conditions before the expansion conducted in 1978, and help to clarify and identify impacts after this time The results of the baseline assessment will be utilized to determine whether subsequent development in and near the harbor has resulted in degradation of the water quality since the expansion in 1978.

2.1 Harbor Waters

It was necessary to characterize water quality at specific sites throughout the Harbor in terms of vertical location in the water column, tidal cycle (when available) and time. Only small amounts of data were available for the Baseline and subsequent studies. Other complications precluded direct comparisons of the datasets[3], however, the relative changes in the water quality benchmarks are discussed. The applicable stations and benchmark concentrations for each study are presented in Appendix A (Figure A-1 through A-4 and Table A-1 through Table A-2, respectively).

[1] The DO degradation benchmark will be presented as % DO Deficit, the difference between the saturation DO for the specified temperature and salinity, and the measured DO.

[2] Orthophosphate is the dissolved form of phosphorous that is immediately available for bio-uptake.

[3] Bienfang (1980) presents datasets as arithmetic means with standard deviations for various depths (0.5 m from surface, 1.5 m and 3 m) at four Harbor sites and one outside the mouth of the Harbor (to represent oceanic conditions/control). OI Consultants (1991) presents results from seven Harbor stations and various outside stations for surface (0.5 m from the surface), mid-depth (variable) and bottom (variable) for low and high tides. Ziemann (2006) presents samples at eight stations throughout the Harbor for surface (0.2 m from the surface) and bottom (0.5 m above the bottom), without a tidal cycle designated.

2.1.1 *Dissolved Oxygen (DO)*

Baseline DO concentrations are of major concern as they show how the oxygen content was affected by the addition or subtraction of nutrients or other effects. Dissolved oxygen content is often used as an indicator of overall water quality. DO concentration is a response to various sources and sinks of which numerous relationships exist, including those listed in Table 2-1. Dissolved oxygen is depleted by oxidation of organic carbon, benthic oxygen demand, nitrification and respiration, and is replenished through phytoplankton production and reaeration at the surface.

Table 2-1: Summary of DO sinks and sources

DO SINKS (CONSUMERS):	
1.	Deoxygenation of biodegradable materials by bacteria and fungi;
2.	Benthic oxygen demand, utilizing oxygen in the upper, oxygenated (aerobic) layer of sediment;
3.	Nitrification of ammonia and organic nitrogen to nitrites and nitrates; and
4.	Respiration[4] by micro algae and macrophytes.
DO SOURCES (PRODUCERS):	
1.	Reaeration at the air-water interface, and
2.	Photosynthesis by the algae and macrophytes.

As a substance enters the water body, constituents either dissolve, settle, or are suspended in the water column for later dissolution, degradation or settling. Soluble constituents such as ammonium, may create "hot spots" of DO depletion, in which water column bacteria immediately seize the constituents as a food source, requiring large amounts of oxygen to degrade the materials. The strength of these materials is usually measured as biochemical oxygen demand (BOD). The BOD effect may be further qualified as carbonaceous or nitrogenous oxygen demands (CBOD or NBOD, respectively), depending upon the energy source in the waste (carbon or nitrogen) utilized by the consuming bacteria.

While "nutrient" effects are generally spoken of with respect to algal production, in reality, the mechanisms of nutrient loading and consequent degradation of the system are significantly different. Ammonium (NH_4) will quickly oxidize to nitrate, requiring 4.57 g-O/g-N, the theoretical oxygen demand for nitrification to NO_3,[5] exerting an immediate oxygen demand in the water column. Nitrate (NO_3) and ortho-phosphate (o-P)[6] are already oxidized, and do not exert

[4] Respiration is the consumption and decomposition of heterotrophs (animals, bacteria and fungi)/ rate of destruction of organic matter in the water column.

[5] Overall, 2 moles of O_2 are required for each mole of ammonia oxidized:

Oxygen required:	2 moles * 32 g-O/mole = 64 g
Ammonia to be oxidized:	1 mole * 14 g-N /mole = 14 g
	64/14 = **4.57** g-O/g-N

[6] "Phosphate" referred to in the Baseline study (Bienfang 1980) is actually ortho-phosphate, which is bio-available, inorganic phosphate.

an oxygen demand. However, they are plant nutrients and whether nitrogen or phosphorous is found to be the limiting factor in algal growth, eutrophication can become a problem. Eutrophication can often be referred to as "overfertilization" of a water body. Originally, this was used to describe the natural progression of a lake to a marsh to a meadow, however the term has been more predominantly used to describe the accelerated aging of a water body, whereby plant-growth within the water body exceeds the expected natural conditions due to human activities (Chapra, 1997)

Detrimental effects to water bodies due to eutrophication can include the excessive quantity of plant growth decreasing the water clarity and species naturally found in the water. In addition, the growth and respiration of plants can affect the oxygen and carbon dioxide levels within the water body. This can affect fish populations. The change in trophic state of the water body significantly affects the entire natural population within the water body, and in the case of Honokohau Harbor could have significant impacts on the coral populations present within the Harbor (Costa *et al*., 2000).

In classic eutrophication scenarios, the waters experience high "nutrient" levels, resulting in algae blooms, die-off, and sedimentation with subsequent unsatisfied benthic oxygen demand, leading to a DO collapse in the water column (EPA, 1985). In the Harbor water column, due to density stratification, algae that dies and falls out of, or is carried away from, the system remains out of the system. A review of the sediment samples[7] (Bienfang, 1980) reveals little organic matter on the bottom, indicating that algae do not die in sufficient numbers to build up an organic blanket on the bottom, and mineralization or denitrification are not contributing to the nitrate in the water column[8]. This is likely due to the high degree of flushing through the existing harbor. Thus, Harbor DO deficit is expected to be primarily from nitrification of $NH_4 \rightarrow NO_3$ and algal respiration.

In the Baseline Harbor study (Bienfang 1980) DO values are considerably lower than the respective DOSat[9] for the temperature and salinity at each station and depth. DO deficits range from 44% below DOSat in the Back Basin surface samples (0.5 m depth) to 24% below DOSat in the ocean samples (5 m depth)[10]. By 1991, the Harbor DO deficits indicate significant improvement; and in 2006, grab samples by Ziemann, corroborate this observation. Mid-Harbor

[7] % Organic materials in sediment cores were tested. Values were extremely low, ranging 0.79-2.81%, were determined to be primarily inorganic, and showed no spatial distribution or trends

[8] During mineralization and de-nitrification, organic nitrogen (from dead algae) is broken down at the soil: water interface. If oxygen in the bottom is in small quantities, NH_4 may be returned to the water column, oxidize to NO_3 and continue the cycle of DO demand and fertilization. In an anoxic bottom environment, N_2 may be formed during the process of de-nitrification and may result in N_2 bubbles leaving the water column through release into the air.

[9] DOSat = -139.34411 + (1.575701 x 105 / T) – (6.642308 x 107 / T2) + (1.243800 x 1010 / T3) – (8.621949 x 1011/T4) - Chlorinity[(3.1929) x 10-2) – (1.9428 x 101 / T) + 3.8673 x 103 / T2)]

where: T = deg. Kelvin
Chlorinity = salinity / 1.80655

[10] Hawaii WQ standards require minimum DO concentrations $\geq$ 75% of DOSat. Both the Back and Front Berthing Basins (stations 1 and 3, respectively) failed this standard in surface samples.

surface DO deficits have improved from a maximum of -44% (1980) to -26% (1991) to -15% (2006) with the greatest improvement seen towards the back of the Harbor.

2.1.2 *Nutrients (NH_4, NO_3 and o-P)*

A review of the Baseline nutrient data showed that soluble nutrients are variable throughout the Harbor. Maximum NO_3-N, o-P and NH_4-N concentrations were observed during ebb tide, surface samples of the Back Berthing Basin in the Baseline study (Bienfang 1980). Since, for all depths, nutrient concentrations are higher toward the back of the Harbor and become lower along Transect A-A' (Figure A-1) towards the ocean (as a result of tidal flushing/dilution), the source of nutrients appears to be in or near the back of the Harbor, corresponding to groundwater inflow.

Ammonium (NH_4)

Ammonium concentrations have decreased in the Harbor over time from the mid-Harbor maximum of 18.8 µg-N/L in the Baseline dataset (Bienfang, 1980) to a minimum[11] of <1 µg-N/L in the 2006 study (Ziemann 2006). Mean values in the Harbor (18.8 µg-N/L) and in the groundwater (14 µg-N/L) will each require < 0.09 mg O/L oxygen to fully oxidize $NH_4 \rightarrow NO_3$. These loads are insufficient to explain the high Harbor DO deficit calculated during Baseline or subsequent conditions. It is probable that the source of NH_4-N is not being characterized by the sampling sites (too variable or not near enough to the source), or it is loaded through an intermittent inflow, such as a rainfall/runoff event. It is also possible that other sources of oxygen demand are present.

Figure 2-1 shows the NH_4-N differences over the eight stations described in Ziemann (2006). It can be seen that in 1991, there is a significant increase in concentration between stations 4 and 6. This indicates that there could be an input into the system around this area. Suspected NH_4-N inputs into the Harbor include: septic sources, anchialine ponds and wildlife. From the historic data, inflows are also apparent at locations mid-Harbor and near the mouth. Mid-Harbor measurements (approximately between Ziemann (2006) stations 4 and 5) correspond to inflow from two restroom facilities: 1) between the Harbor Back and Front Berthing Basins and 2) north of the Harbor on the Honokohau Beach in the National Park (Hoover and Gold, 2005). The concentrations of NH_4 from these suspected sources are expected to be higher than that measured in groundwater; however, no corroborating inflow data has been collected at these sites.

[11] Ziemann (2006) provided only grab samples for the Harbor – one sample at each of the sites for the surface and bottom depths, so the single observations may not be representative of the Harbor water quality.

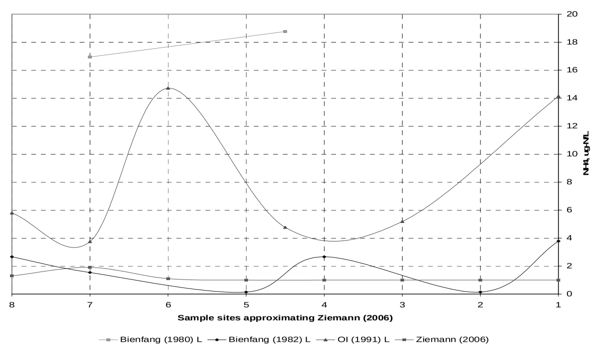


Figure 2-1: Ammonium surface concentrations

Nitrate (NO_3)

Nitrate concentrations have increased over time, where the lowest concentrations were measured in 1991 (OI, 1991) and the highest in 2006 (Ziemann, 2006). In addition to the nitrification of NH_4 as a source of NO_3-N in the Harbor, the dominant source of nitrogen in the Harbor is from groundwater[12]. Thus, characterization of this major source is critical to understanding the water quality evolution in the Harbor. One characteristic value for both NO_3-N and o-P in groundwater was provided in the Baseline study (Bienfang, 1980). Concentrations are significantly higher for groundwater than within the Harbor itself, but there are insufficient data to characterize the "groundwater signature" for the baseline conditions. Supplemental studies were consulted to provide additional characterizations of groundwater into the Harbor (Waimea Water Services, 2006 and Hoover and Gold, 2005). Marked variations in concentrations were seen across the sampled wells; however, using values nearest to the Harbor (Waimea Water Services, 2006), the values were fairly consistent with Bienfang (1980). In addition, the groundwater was studied by Hoover and Gold (2005) and nutrients were found to have a linear relationship with salinity. This corroborates the discussion by Oki *et al*. (1999) which describes the groundwater system with respect to oceanic inflow. This is further discussed in the hydrodynamics section. However, it suffices to say that a linear relationship of the nutrients found in the groundwater with salinity also corroborates values found by Bienfang (1980) and Waimea Water Services (2006).

If groundwater, which is the primary load of NO_3-N into the Harbor, is constrained to the average concentrations that were collected, the Harbor NO_3-N values would be expected to be lowered significantly because of dilution. Dilution was sufficient to explain the Harbor NO_3-N concentrations at most sites. Unexplained increases in NO_3-N in mid-Harbor suggest that additional NO_3-N is being "created" in the Harbor from nitrification of $NH_4 \rightarrow NO_3$ or loaded directly into the Harbor. Thus, the loading of NH_4-N into the Harbor must be higher than the groundwater NH_4-N measurements suggest, or there are additional unidentified loads of NH_4-N

[12] Bienfang (1980) states that coastal groundwater is high in NO_3 due to the geochemistry of the confining layer.

or NO_3-N flowing into the Harbor. Nitrate inflows are apparent in several studies at mid-Harbor stations (between Ziemann stations 4 and 5), corresponding to a restroom facility between the Back and Front Berthing Basins) and near the mouth (between Ziemann stations 6 and 7 (Ziemann, 2006)) as is shown in Figure 2-2.

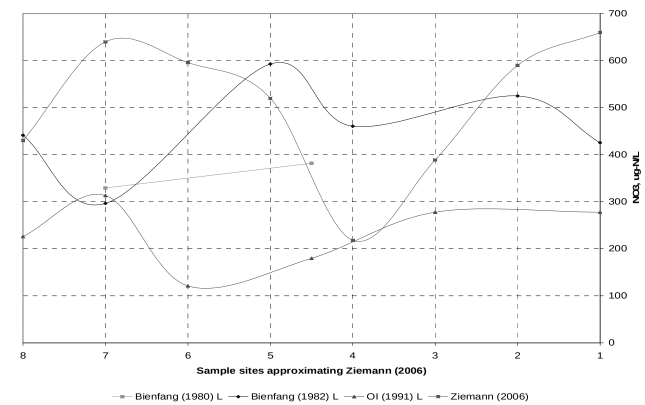


Figure 2-2: Nitrate surface concentrations

Orthophosphate (o-P)

Phosphorus is one of several macronutrients required for the growth of marine organisms. In open ocean marine ecosystems, phosphorous is often present in low and, often limiting, concentrations for microalgal and bacterial populations. In the assessment of phosphorous from the various studies in the Honokohau Harbor, "phosphorous," "phosphate," "orthophosphate" and "soluble reactive phosphorous (SRP)" were measured. Identification of the analytical methods used for all samples indicated that the constituent measured, in all cases, was inorganic ortho-phosphate (o-P)[13].

Ortho-phosphate in the Harbor has decreased over time. The highest concentrations were measured in the Baseline study (Bienfang 1980 and 1982). The values decreased in 1991 and are at their lowest in 2006. These reductions in Harbor concentration imply that o-P loading has decreased, possibly due to improvements in nearby wastewater systems. An unidentified load of o-P is introduced near the Harbor mouth (between Ziemann stations 6 and 7), which is shown in Figure 2-3. The slight increases seen in Ziemann (2006) and OI Consultants (1991) are unattributable. They could be due to any number of factors; however, the fact that they do occur in two datasets indicates that it is not a data anomaly, but some sort of consistent source of nitrate and phosphate at this point. Stations 6 and 7 are located in different areas of the Harbor, with 6 being located in a narrow channel connecting the front and back berthing bays. Station 7 is located in a cul-de-sac of sorts immediately outside of this narrow channel. It could be that

[13] Orthophosphate is the dissolved form of phosphorous that is immediately available for bio-uptake.

there is a nutrient source near to this cul-de-sac, however it cannot be determined from this data what this source may be.

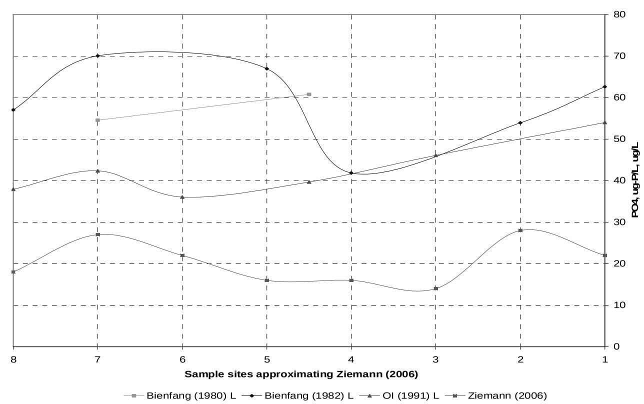


Figure 2-3: Phosphate surface concentrations

2.1.3 Supplemental Documentation for Source Loads

N:P Ratio

The nitrogen to phosphorous ratio (N:P)[14] is revealing as an indicator of pollutant origin. In nitrogen-limited waters (where nitrogen is the limiting nutrient), this ratio is expected to be <7.2:1 (Chapra, 1997). Waters where N:P>7.2:1 indicate that phosphorous is the limiting nutrient. Where nitrogen is severely limited, nitrogen-fixation[15] by blue-green algae may occur. In waters receiving wastewater effluent, the ratio is about 4 or 5:1 (Thomann and Mueller, 1987 and Chapra, 1997).

Chapra (1997) claims that typical marine waters and estuaries have an inorganic nitrogen to inorganic phosphorous ratio of about 2. However, in the waters offshore of Honokohau Harbor, the ratio of inorganic nitrogen to inorganic phosphorous is about 7.5 indicating that the system is fairly neutral as to its limiting nutrient.

[14] Literature states that the stoichiometric ratio of C:N:P taken up by algae during photosynthesis is 106:16:1 and the stoichiometric composition of the diatom and the typical green algae is O:C:N:P (109:41:7:2:1). (Chapra, 1997)

[15] This species of algae "fix" nitrogen directly from the atmosphere. This is considered a "nuisance" algae in managed waters, but may be essential in naturally nutrient-poor waters.

The N:P relationship for the waters within the Harbor and groundwater sources ranged in the region of 6:1-10:1[16] for all datasets (indicating nitrogen-limitation), except for the grab samples presented by Ziemann (2006), in which N:P ranged from 14-30 in surface samples and from 12-40 in bottom samples. The Ziemann (2006) data suggest that the system has become significantly phosphorous-limited since the 1991 intensive survey.

Bacteria

Enteric bacteria levels (total coliform, TC; fecal coliform, FC; and fecal streptococci, FS) in the water column are indicators of sewage contamination. The nature and source (human versus nonhuman) of the contaminants can be ascertained through measurements and ratios of the constituents. Waters that have ratios of FC/FS >1 are more likely to have been contaminated by human wastes. Bienfang and Johnson (1980) pointed out that possible sources of nitrogen and bacteria in the Harbor were from nearby "leaking/leaching septic sources and wildlife usage".

Except for the connecting channel between the Back and Front Berthing Basins (mid-Harbor), most stations indicated non-human origins. However, the increased bacterial counts and FC/FS ratios>1 in the Berthing Basins, indicates that sewage effluents are leaching from the septic facility near this location, because of the permeability of the lava walls within the Harbor (Bienfang, 1980).

2.1.4 Algal Responses (Chlorophyll a)

Algae (phytoplankton) affect the DO through photosynthesis and respiration. Diurnal DO measurements are usually made to verify and quantify the impacts of eutrophication. These data are not provided in Bienfang and Johnson (1980), but Primary Production was calculated and presented. Overall, the Harbor contains low phytoplankton biomass (measured as CHLa). CHLa is lowest in the brackish surface layer (0.5 m), increasing with increased salinity and warmer temperatures found at the lower depths. CHLa is highest in the mid-Harbor (Back Basin, approximately in between stations 4 and 5 of Ziemann (2006)) at the 1.5 m and 3.0 m depths, followed by the connecting channel (approximately between stations 5 and 6 of Ziemann (2006)) and falling off at the Front Basin (approximately at station 7 of Ziemann (2006)). In the Back Basin the measured values (weight and numbers) were about 28 times higher than those measured in both the Front Basin and the Ocean/control sampling stations (Bienfang, 1982). It appears that the phytoplankton select for the more quiescent conditions in the back basin at mid-depth (1.5 – 3.0 m depth) which optimizes salinity, temperature, light, and nutrients as observed in Bienfang (1982) and OI Consultants (1991). Pheophytin (a breakdown product of CHLa) was measured, yet provided no additional information or trends.

As a result of photosynthesis, algae strip CO_2 from the water column, resulting in increased pH, which is another indicator of eutrophication. Bienfang and Johnson (1980) verified that pH values were highest in samples taken at 3 m depths (corresponding to maximum CHLa measurements), but did not present data. Lowest pHs were found in the brackish surface samples (0.5 m depth), which is also not surprising due to generally low pH in groundwater.

[16] Bienfang (1980) discusses ratio N:P=15 within the groundwater, which is the ratio in the unconverted/non-normalized datasets (ug-atom/L), whereas the actual N:P ratio is approximately 7.

Regardless of tidal cycle or area of highest loading (Back Basin), the turbidity is greater than 90% transmittance, indicating that the high flushing is maintaining the water clarity (Bienfang and Johnson (1980)). Bienfang (1982) claims that the source of most of the turbidity within the water column is due to phytoplankton, and that post-expansion, the areas within the expanded harbor were most turbid. The clarity of the water allows penetration of light to deeper depths and acts as an enhancement to algal and coral growth.

3. HYDRODYNAMIC MODEL DEVELOPMENT

3.1 Overview of Delft3D Modeling System

Modeling was performed using the Delft3D modeling system. Delft3D, which was developed by WL| Delft Hydraulics, is a state-of-the-art integrated surface water modeling system based on a flexible framework capable of simulating two- and three-dimensional interactions between flow, waves, water quality, ecology, sediment transport and bottom morphology. The system gives direct access to state-of-the-art process knowledge, accumulated and developed at one of the world's oldest and most renowned hydraulic institutes. Delft3D consists of a number of well-tested and validated modules, which are integrated with one another.

The Delft3D FLOW module was specifically used to simulate the hydrodynamics of Honokohau Harbor. This module is capable of simulating two-dimensional (2D, depth-integrated) or three-dimensional (3D) unsteady flow and transport phenomena resulting from tidal and/or meteorological forcing, including the effect of density differences due to a non-uniform temperature and salinity distribution (density-driven flow). This model can be used to predict the flow in shallow seas, coastal areas, estuaries, lagoons, rivers and lakes. It aims to model flow phenomena where the horizontal length and time scales are significantly larger than the vertical scales. When the fluid is regarded as vertically homogenous with respect to temperature, salinity, and thus density, a depth-averaged approach is appropriate.

Delft3D-FLOW's system of equations consists of the horizontal equations of motion, the continuity equation and the transport equations for conservative constituents. The equations are formulated in orthogonal curvilinear coordinates. In curvilinear coordinates, the free surface level and bathymetry are related to a flat horizontal plane of reference. Flow forcing may include tidal variation at the open boundaries, wind stress at the free surface and pressure gradients due to free surface gradients (barotropic) or density gradients (baroclinic). Source and sink terms are included in order to model the discharge and withdrawal of water. Delft3D-FLOW solves the Navier-Stokes equations for an incompressible fluid, under the shallow water and Boussinesq approximations. In the vertical momentum equation, the vertical accelerations are assumed to be negligible and are neglected; this leads to the hydrostatic pressure equation.

3.2 Existing Conditions

3.2.1 Model Grid

The numerical model grid is shown in Figure 3-1. The model extent is approximately 9,700 m alongshore and 2,500 m cross-shore. Grid size is variable throughout the domain. The largest grid cells are located near the open boundaries with dimensions on the order of 180 m by 270 m, while the smallest grid cells are located at the existing harbor with a resolution of approximately 25 m by 25 m. The offshore boundary is located at a depth of roughly 650 m.

The vertical grid consists of layers bounded by two sigma planes, which are not strictly horizontal but follow the bottom topography and the free surface. Because the σ-grid is boundary fitted both to the bottom and to the moving free surface, a smooth representation of the topography is obtained. The number of layers over the entire horizontal computational area is constant, irrespective of the local water depth. A total of 8 layers are used in the model.

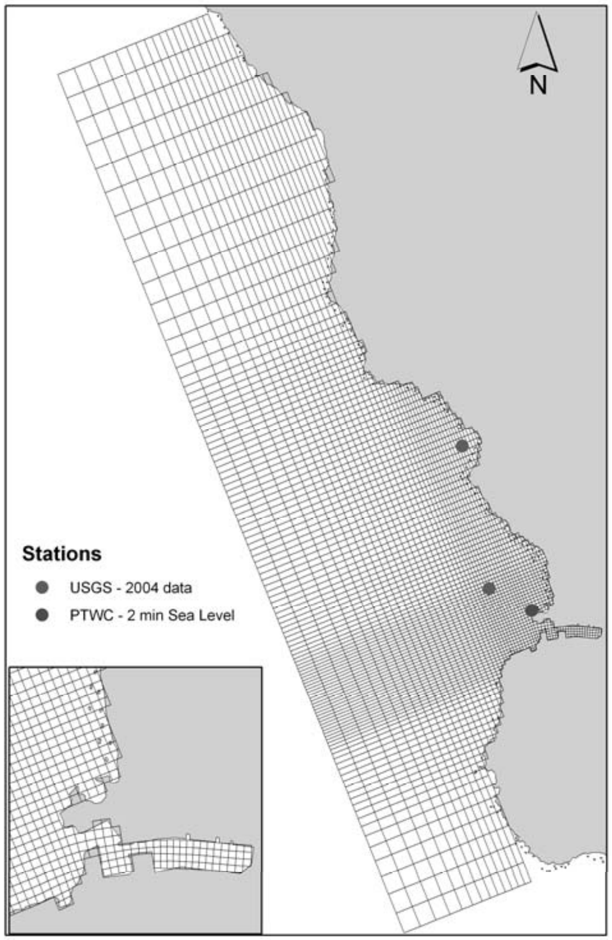


Figure 3-1: Model grid and location of available data

3.2.2 *Model Bathymetry*

The model bathymetry is presented in Figure 3-2. The near-shore bathymetry was created using data collected by the SHOALS (Scanning Hydrographic Operational Airborne Lidar Survey) system to a depth of -30 m MSL. At the harbor the bathymetry was created using the available navigation chart. Offshore areas were constructed from surveys collected by the National Oceanographic Service (NOS) of NOAA and available via their GEODAS system.

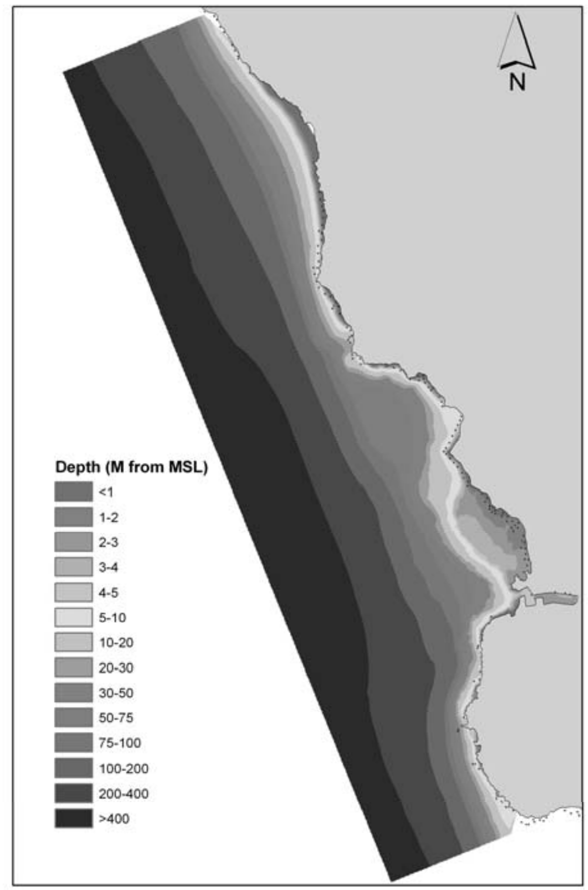


Figure 3-2: Model bathymetry

3.2.3 Boundary Conditions

The model was constructed with open-ocean forcing at its offshore boundaries. Detailed water level measurements along this boundary are not available. Instead, tidal constituents derived from available data can be used to construct a time series of water elevations. Water level measurements along the west coast of Hawaii are available at 4 stations (see Figure 3-3). Three of these gauges, Mahukona, Honokohau and Milolli are maintained by the Pacific Tsunami Warning Center (PTWC), and the gauge at Kawaihae is maintained by the National Ocean Service (NOS). Data at Mahukona and Milolli are on a 5 second interval and only available until 2004. Data at Honokohau are available on a 2-minute interval and available to the present. The detailed location of this station is presented in Figure 3-1. Data at Kawaihae are available on a 6-minute interval and are available to the present.

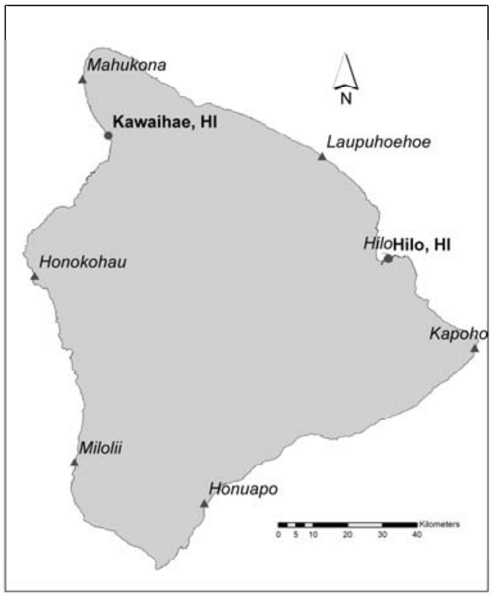


Figure 3-3: Available water elevation stations in Hawaii.

The two stations closest to the project location also measured more recent data. These stations, Kawaihae and Honokohau, were used to define the model boundary conditions. The distance between these two stations is approximately 50 km. One year of data was used to compute the 8 main tidal constituents at these two stations. These 8 tidal constituents are described in Table 3-1.

Table 3-1: Description of Tidal Harmonic Constituents

Harmonic Constituent	Speed (deg/hr)	Period (hr)	Description
O1	13.943	25.819	Principal lunar diurnal constituent
K1	15.041	23.935	Solar-lunar constituent
Q1	13.398	26.870	Larger lunar elliptic diurnal constituent
P1	14.959	24.066	Solar diurnal constituent
M2	28.984	12.421	Principal lunar tide
S2	30	12.000	Principal solar tide
N2	29.439	12.659	Monthly variation in lunar distance

The amplitude and phase of the 8 tidal constituents were extracted using the MATLAB toolbox "T-tide" (Pawlowicz *et al*., 2002). Values are presented in Table 3-2.

Table 3-2: Extracted Harmonic Constituents at Kawaihae and Honokohau

	Kawaihae (NOS)		Honokohau (PTWC)	
Harmonic Constituent	Amp (m)	Phase (deg)	Amp (m)	Phase (deg)
M2	0.200	58.2	0.196	45.0
N2	0.036	49.6	0.032	38.7
K2	0.020	55.6	0.016	36.2
S2	0.065	64.1	0.074	52.1
K1	0.158	226.3	0.154	219.4
P1	0.049	223.7	0.038	216.0
O1	0.089	214.0	0.083	209.8
Q1	0.013	204.3	0.012	198.5

The hydrodynamic model was forced by water levels at the offshore boundary and water level gradients at the lateral boundaries (north and south). These gradients were interpolated from the two stations presented in Table 3-2. Water levels at the offshore boundary consist of tidal predictions from interpolated tidal harmonic constituents of the two available stations. The phase difference for each constituent between these two stations was also computed. These stations are approximately 50 km apart while the model lateral boundaries are separated by 10 km; therefore a fifth of the phase difference was applied between the north and south model boundaries.

Salinity concentration and water temperature at the offshore boundary were selected as 34 ppt and 25 ºC respectively. These values are constant with depth and are based on the farthest offshore measured values presented in Ziemann (2006)

3.2.4 *Typical Conditions Assumptions*

The conditions modeled within the hydrodynamic and subsequently the water quality model are meant to represent typical conditions. The hydrodynamic model extents are not sufficient to simulate extreme events that would introduce significant surge or result in higher velocities such as tropical cyclones or tsunamis. It also does not include local wave effects or oceanic currents. The hydrodynamic conditions represented by the model include tidal elevations and include groundwater inflow, represented as point sources. The hydrodynamic model also incorporates typical heat flux conditions including relative humidity, air temperature, solar radiation, and percent cloud cover. Evaporation and conduction were also included in the computation. Each value entered into the heat flux model was taken as a typical day. One month of hourly solar radiation data was obtained from the Hilo weather station (Figure 3-4). A full year of daily atmospheric data was obtained from the Western Regional Climate Center. These data consisted of daily minimums and maximums (Figure 3-5 and Figure 3-6). The average minimum and maximum for the year were computed and used to extrapolate a daily time series of relative humidity and air temperature values. The extrapolated time series for these values are shown in Figure 3-7 and Figure 3-8 respectively. An average value of 250 J/m^2/s was computed as the model input for solar radiation, and daily variations were computed by the model.

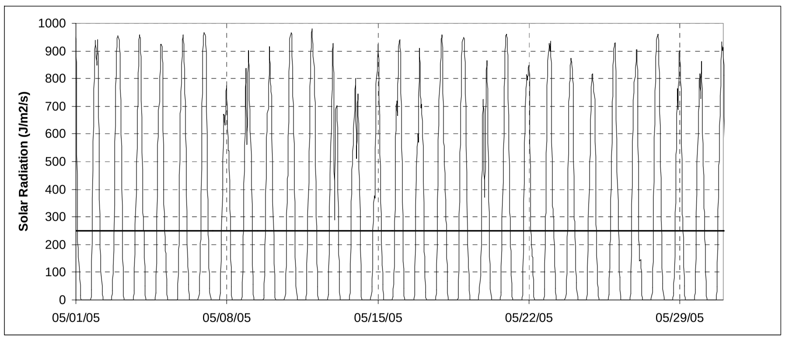


Figure 3-4: Solar Radiation

Figure 3-5: Maximum (red) and minimum (blue) air temperature

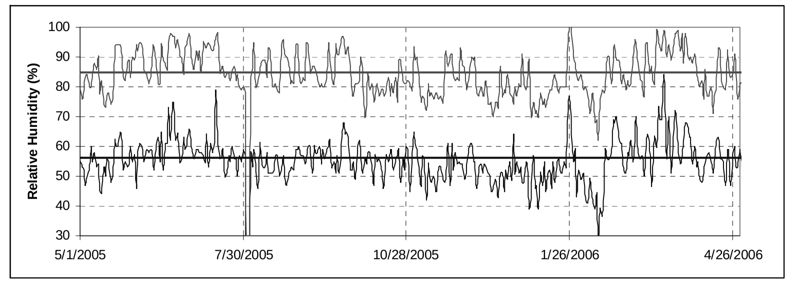


Figure 3-6: Maximum (red) and minimum (blue) relative humidity

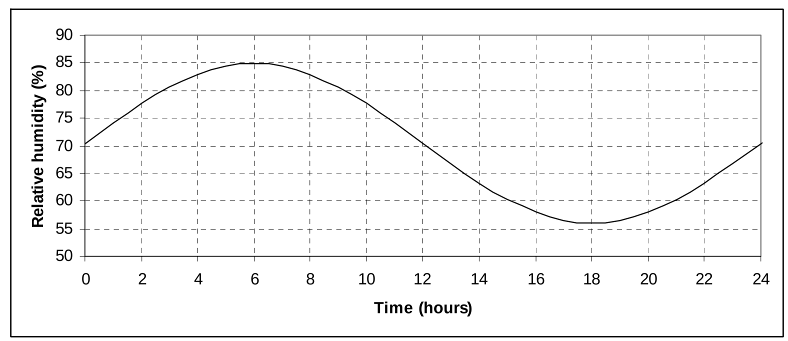


Figure 3-7: Average daily relative humidity

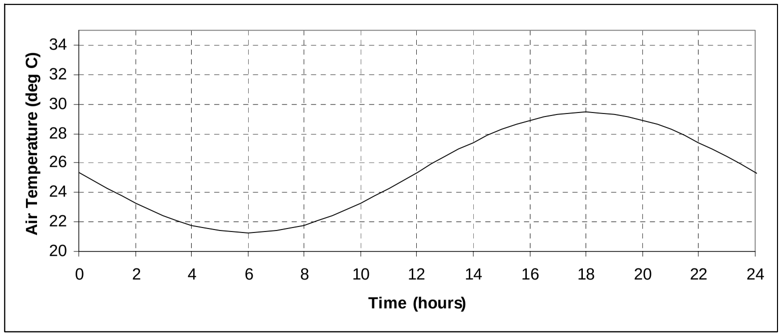


Figure 3-8: Average daily air temperature

3.2.5 *Water Level Calibration*

Model calibration was performed for May 2004 in order to coincide with the data collection period of Storlazzi and Presto (2005). The location of the stations for this study period is shown in Figure 3-1. Hourly values at the south station were provided by the National Park Service (NPS) covering the period 4/30/2004 to 10/30/2004. The data included depth, current speed and direction at 3 and 12 meters, significant wave height, wave period, temperature and salinity. Two-minute water level data from PTWC at Honokohau is also available for the same period.

Since tidal predictions were used to force the model at the open boundaries, the differences between measured and simulated water levels, are mainly due to differences between tidal predictions and water levels. As mentioned in previous sections, only 8 constituents were used to create the tidal open boundaries. The correlation coefficient between the PTWC water level data and the tidal predictions at this location is 0.93, and the Root Mean Square (RMS) error is 7 cm. These differences are the same as those obtained at the measurement location by comparing the measured and simulated water levels. Figure 3-9 shows time series of water levels from PTWC, USGS south station and simulated during May 2004.

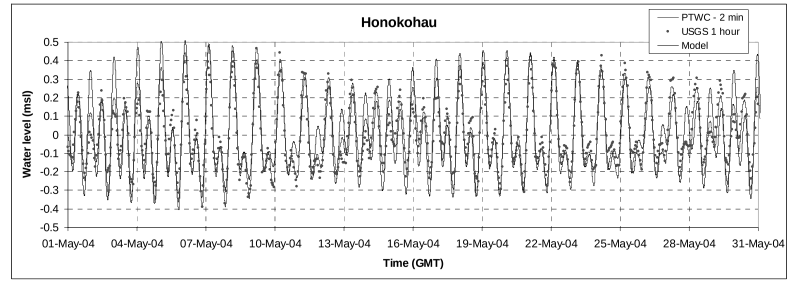


Figure 3-9: Water level data and modeled at Honokohau during May 2004

3.2.6 *Velocity Calibration*

Figure 3-10 presents simulated tidal flow fields at surface and bottom during peak ebb and flood on the 16th of May 2004. It can be observed from the figure that flood tidal currents are generally higher than ebb tidal currents, which is probably associated to the mixed tides of this area. In addition, the current reversal offshore is not present on the shallow area of Honokohau Bay, where the surface ebb tidal current is also moving north. The maximum tidal currents at the surface near the site of the USGS south measurement (see Figure 3-1) are in the order of 0.15-0.2 m/s, with an average value in the order of 0.07 m/s (Storlazzi and Presto, 2005 reported values of 0.09±0.07 m/s 3 m below the surface). In addition, the simulated primary flow direction at the USGS south location is approximately parallel to the shore, as presented in Storlazzi and Presto (2005). For example, the semi major axis of the largest constituent (M2) of the simulated tidal currents at the south location is approximately 0.05 m/s and is approximately parallel to the shore (varies between 25 and 15 degrees counterclockwise from North at surface and bottom).

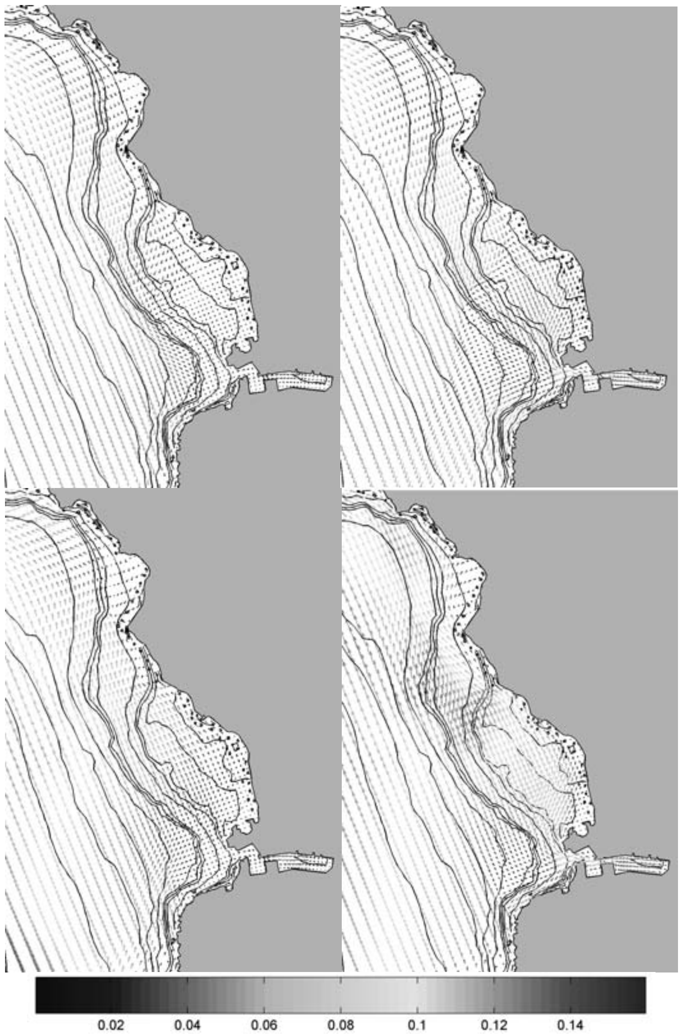


Figure 3-10: Simulated flow patterns during ebb tide (top) and flood tide (bottom) at bottom (left) and surface (right) layers on the 16th of May, 2004 (velocities in m/s)

The effect of the salinity gradients at the harbor are also observed in the currents. The surface current at the harbor entrance is always moving seaward while the current at the bottom is always moving landward. This is also observed in Figure 3-11 which presents the simulated velocity profiles at the harbor's entrance under peak ebb and peak flood conditions. It can be concluded from Figure 3-11 that the vertical distribution of velocities at the entrance shows high velocities in the surface moving seaward, and velocities entering the harbor in the bottom layers, as a consequence of the density stratification created by the brackish groundwater inflow into the harbor. Vertical distribution (with the position of zero velocity at a depth between 1.5 and 2.5 m) and magnitudes of the velocities are very similar to those described in Gallagher (1980) and the ADCP measurements presented in the Oceanit Laboratories (2006).

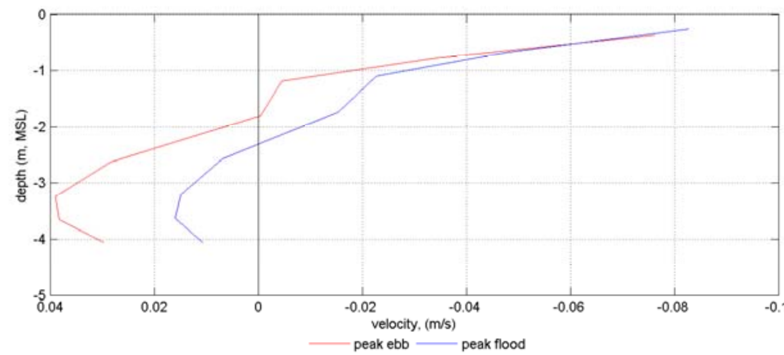


Figure 3-11: Velocity profile at harbor entrance

Figure 3-12 shows location of all cross-section and depth profiles extracted from the model and that are shown throughout the report. The cross-section of the existing harbor (Transect EH) is shown in red, while the cross-section of the future Marina is shown in purple (Transect NM). Figure 3-11 is taken from the harbor mouth point also shown in Figure 3-12.

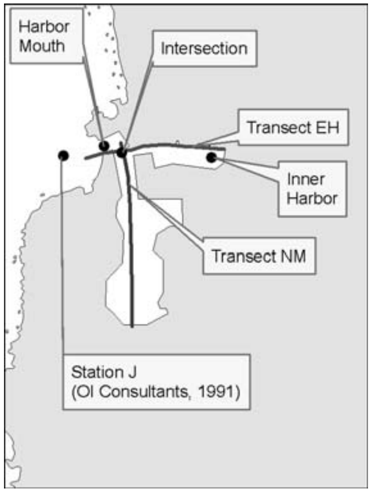


Figure 3-12: Locations of cross-sections and depth-profiles

3.2.7 *Ground Water and Salinity/Temperature Calibration*

The regional groundwater flow system with particular interest in the Kaloko-Honokohau National Historical Park area is described with detail by Oki *et al*. (1999). The study indicates that the groundwater flow system in the vicinity of the Park is part of the regional brackish-water transition zone. Oki *et al*. (1999) also assume that the main freshwater component of brackish water flowing through the Park is from subsurface flow originating from inland areas east of the Park. Brackish ground water forms by seaward flowing freshwater mixing with saltwater. The area of extensive mixing with saltwater extends upgradient from the Park. The brackish groundwater body overlies saltwater and extends to an estimated depth of about 50 to 100 feet at the inland boundary of the Park where the ground water is freshest. The study also indicates that because of the highly permeable offshore volcanic-rock outcrops, saltwater can easily enter the aquifer, and that a saltwater-circulation system exists beneath the freshwater lens. Saltwater flows landward in the deeper parts of the aquifer, rises, and then mixes with seaward-flowing freshwater. This mixing creates a brackish-water transition zone. In areas near the coast where saltwater mixes thoroughly with seaward-flowing freshwater, a freshwater lens may not form and brackish water may exist immediately below the water table. This is the case at the location of the existing harbor, and based on the available measurements it appears that the harbor was built in a location intercepting the layer of brackish water flowing seaward. A schematic view of the groundwater flow system is presented in Figure 3-13, which was taken from (Oki *et al*., 1999).

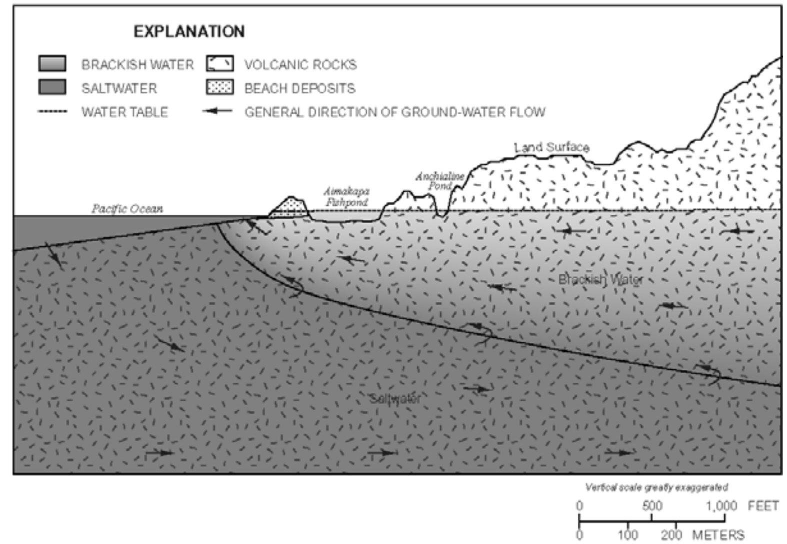


Figure 3-13: Schematic cross-section of the groundwater flow system in Kaloko-Honokohau National Historical Park, Island of Hawaii (Source: Oki *et al*., 1999)

The groundwater inflow into Honokohau Harbor has been reported in a number of studies as both freshwater and brackish water. The circulation within Honokohau Harbor is controlled by the influx of brackish groundwater, and determining the appropriate value for this source is imperative. Salinity and temperature distribution in the Harbor are controlled by both advection and dispersion effects. The advection component is dominated by the circulation in the harbor, which is a combination of tidal currents and currents generated by the two layer system created by the groundwater inflow. The dispersion part represents the scattering of a substance (salinity or temperature in this case) by effects of shear and diffusion. Therefore, it is necessary to estimate the rate of the brackish groundwater inflow into the harbor and the dispersion coefficient of the groundwater to correctly simulate, with the numerical model, the conditions at the Harbor.

Review of Available Information

This section summarizes the information obtained from some of the available studies regarding three different variables:

- Groundwater inflow into the harbor,
- Salinity and temperature profiles, and
- Flushing time.

Groundwater inflow

Bienfang (1980) described the water quality characteristics of Honokohau Harbor before the harbor expansion. The study mentions that the continual groundwater influx into the harbor, in the order of 1.5-2 million gallons of fresh water per day, produces harbor flushing rates six to ten times those calculated by tidal flushing alone. Bienfang (1980) based his estimate on the results from Cox *et al*. (1969) who said that the groundwater inflow in the Honokohau area is comparatively low because of the small recharge resulting from low rainfall and high evapotranspiration conditions of the area. Cox *et al*. (1969) estimated groundwater discharge in the Honokohau shoreline area to be a few millions gallons of freshwater per day per mile. Although in Bienfang (1980) it was mentioned that excavation of the harbor has displaced the natural discharge points in the immediate area landward, and that this displacement may also have caused enhanced discharge in this area, his oceanographic analysis still estimates the groundwater discharge into the harbor to be in the same order of the one suggested in Cox *et al.* (1969) along the shoreline.

A study also presented in 1980 by Gallagher, in same journal issue and under the same funding as Bienfang (1980), focused on the physical structure and circulation in the harbor. Using an extensive measurement campaign, this study concluded that the springs in the harbor were contributing on the order of 70 m^3/min (~27 mgd) of brackish water with an average salinity of 25 ppt during both ebb and flood phases of the tide. Gallagher (1980) also indicates that the bottom spring inflow rate is greater than the tidal exchange rate in the harbor, which is the cause of the pronounced layering and vigorous circulation. In addition, this study concluded that the flushing time of the harbor is in the order of 12-13 hours due to the existence of the strong flow of brackish water from the springs.

A recent study (Glenn, 2006) used infrared images and natural tracers to estimate the coastal groundwater discharges. Similar values were obtained from 3 coastal sites while at Honokohau Harbor the fluxes were estimated to be in the order of 20 times higher. Glenn (2006) indicates that this is likely the result of constructing the harbor at a level that intercepted the water table, resulting in "anthropogenically enhanced" flow. This study did not provide an estimate of the volume of brackish water flowing into the existing Harbor.

Salinity and Temperature Profiles

Salinity profiles from different studies indicate that under different tide conditions, the 29 ppt contour extends to a distance between 400 and 500 meters from the back Harbor wall. During the 1991 study by OI Consultants, this is observed for both high and low tide. Figure 3-14 shows the period where salinity and temperature cross sections were measured at Honokohau Harbor, (red shows the salinity and temperature cross sections at High Tide and green those at Low Tide). The salinity profiles are presented in Figure 3-15 and Figure 3-16.

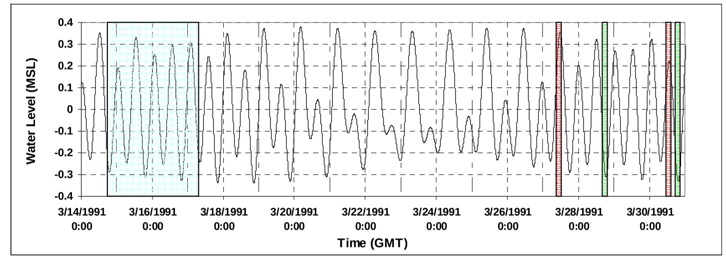


Figure 3-14: Studies in 1991

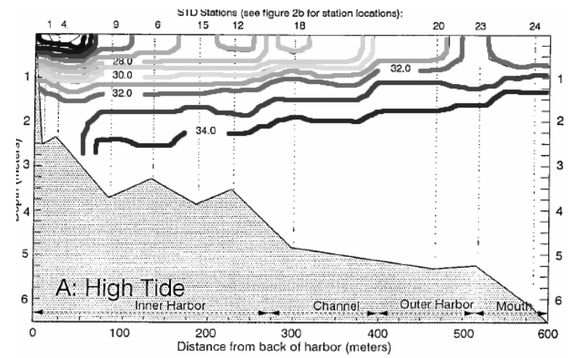


Figure 3-15: Salinity contours at high tide –27 March 1991, from OI Consultants, 1991

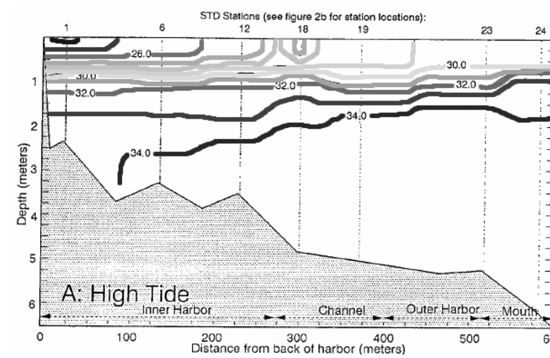


Figure 3-16: Salinity contours at high tide –30 March 1991, from OI Consultants, 1991.

A more recent report presented by University of Hawaii (Glenn, 2006) (see Figure 3-17) also shows that the 29 ppt contour at the surface extends to approximately 500 meters from the back Harbor wall. Finally, recent data collection by Oceanit Laboratories between April 3 and 13, 2006 (Ziemann, 2006) showed a surface salinity of 28.9 ppt at the Harbor entrance, approximately at 500 meters from the back Harbor wall.

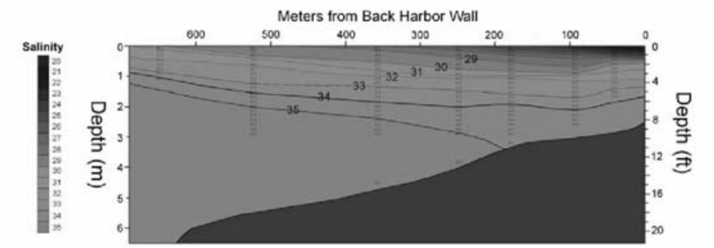


Figure 3-17 : Salinity distribution in February 2006 from University of Hawaii, C. Glenn, November 2006

The consistency of available historical and recent measurements indicate a very stable salinity distribution in the harbor which is probably associated more to the location of the harbor in relation to the density gradients in the groundwater system than to the head differences in the aquifer.

Flushing Time

After the harbor expansion, OI Consultants subcontracted Noda and Associates, Inc. to perform a dye study in order to assess the flushing time of the Harbor. This study was conducted over a 4 day period in March, 1991. Figure 3-14 shows in blue the period when the dye study in the Harbor was carried out (OI Consultants, 1991) together with the water elevation in the Harbor. Rhodameine WT dye in a 20% aqueous solution (about 5 gallons) was injected throughout the Harbor during a five hour period (flooding tide) ending at 13:00 on March 14, 1991. The deployment of the dye was designed such that the dye would be vertically and spatially uniform throughout the Harbor. Measurements were taken at 8:00 on March 15, 16, 17, and 18 in order to assess the concentration throughout the Harbor. The method, described in one of the following sections, was used to determine the residence time at five stations throughout the Harbor.

The analysis was first applied to tidal-only flow exchange with the ocean waters (OI Consultants 1991). The tidal flushing time was computed to be approximately 3.2 days. Measured results from the five stations within the Harbor show much shorter residence times, with stations in the inner part of the Harbor having average residence times of 0.4 days. It was also shown that the residence time at all stations was fairly depth independent indicating that the mixing of the tracer dye and "fresh" water was fairly consistent throughout the Harbor. The representative flushing time for the entire Harbor was the average of all five stations and was 0.42 days, which is 7.6 times faster than the tidal flushing time.

OI Consultants (1991) also noted that the tidal prism is about 16.5 million gallons per day (mgd) and that using the groundwater intrusion calculated by Bienfang (1980) of 1.5 to 2 mgd represents only about 9% to 12% of the flushing volume. This is counterintuitive to the results presented, and indicates that the 1.5 to 2 mgd of groundwater intrusion refers to fresh groundwater and not the total volume of brackish groundwater that enters the Harbor, which could be a significantly larger amount. Gallagher (1980) reported intrusion rates within the Harbor of 70 m^3/min or 27 mgd of brackish groundwater, which is equivalent to 9.5 mgd of pure fresh water. Gallagher (1980) found using a numerical model that the residence time of the Harbor was on the order of 12-13 hours or 0.5-0.54 days.

Calibration data

Based on the available information presented in the previous section, brackish groundwater inflow and the dispersion coefficient in the numerical model were calibrated to meet the following observations:

- Most of the data indicates that the 29 ppt contour at the surface extends to a distance between 400-500 m from the Harbor back wall.
- The depth of the 33 ppt contour is very stable in most of the data sets. Gallagher (1980) used this contour to define an arbitrary boundary between the top and bottom layers inside the Harbor.
- Flushing time should vary between the values reported by OI Consultants (1991), 0.42 days or 10 hours, and those reported by Gallagher (1980), 0.5-0.54 days or 12-13 hours.
- Flushing time is homogeneous with depth as reported by OI Consultants (1991).

Brackish Groundwater Inflow and Dispersion Coefficient Calibration

The selected calibration period coincides with the time when OI Consultants (1991) performed the dye study. For each combination of brackish groundwater discharge and dispersion coefficients, the transport of a conservative tracer was carried out using a coupled hydrodynamic and water quality model. The model was seeded with a conservative tracer up to the mouth of the harbor with an initial concentration of 1 g/m^3 at each vertical layer. Outside of the harbor, the concentration was set with an initial value of 0 g/m^3. Conservative tracer model simulations were started at the point of last release of the Rhodameine dye at 13:00 March 14, 1991.

To compare model results to the analysis presented in the study conducted by OI Consultants, Inc., the computation of a flushing time constant, *T*, was used to represent the residence time in the harbor. The same method of computing the residence time used by OI Consultants (1991) was applied in this study. The method is summarized in the following paragraphs.

The concentration of a constituent within an enclosed body of water like a harbor which is dominated by tidal effects can be described by

$$C = C_0 e^{-t/T}$$

Where C_0 is the initial concentration and C is the concentration of the constituent at time t. T is considered to be the flushing time constant or the residence time of the particle in units of time. This approach is often referred to as the "e-folding" approach. The residence time, T, can be considered to be the time required for reduction of a conservative tracer concentration to $1/e$ or

36.8% of its initial value, or a reduction of 63.2%. Mathematically, assuming an exponential distribution of times for individual water particles to reach the ocean, when the concentration of particles reaches 1/e, it represents the average time of all particles to reach the ocean.

If the natural logarithm of the above equation is written as

$$\ln(C) = \ln(C_0) - t / T$$

then it is seen that the natural logarithm of the concentration of a tracer is a linear function of the time with a slope of -1/*T*. In this way, the residence time can be estimated without knowing the initial concentration.

Several combinations of brackish groundwater discharge and dispersion coefficients were simulated. These simulations used a combination of values of brackish groundwater discharge between 8 and 55 mgd and a dispersion coefficient between 0.1 and 1.0 m^2/s. The salinity concentration of the brackish groundwater discharge was selected to be 22 ppt and the temperature 20 ºC, which is in the order of the values observed near the back wall of the existing Harbor.

The following conclusions were obtained from the analysis of the model results

- Groundwater discharge controls the flushing rate of the surface layer. For example, when the inflow rate was kept at a low value such as 4 to 8 mgd, the flushing rate of the surface layer varies between one and more than two days depending of the dispersion coefficient applied.
- The observed vertical salinity distribution in the harbor, with the 29 ppt contour at the surface reaching a distance of 400-500 m from the back wall is only obtained for brackish groundwater discharges larger than 20-25 mgd.
- The field study conducted by OI Consultants (1991) shows flushing time constants within the Harbor to be fairly uniform with depth. In order to achieve the mixing of the conservative tracer throughout the depth layers, a dispersion coefficient closer to the upper limit of the selected range (horizontal dispersion coefficients were varied between 0.1 m^2/s and 1 m^2/s) was needed. It was found that using dispersion coefficients at the upper limit promoted too much mixing, impacting the top layer thickness throughout the Harbor, independently of the flow rate used. For example a flushing time in the order of 12 hours could be obtained for a groundwater discharge as low as 20 mgd but for a dispersion coefficient of 1 m^2/s, which produces excessive vertical mixing creating a top layer (salinity values smaller than 33 ppt) thicker than observed. On the other hand, using dispersion coefficients at the lower limit caused little to no mixing of the conservative tracer in the lower layers over the three day period.
- The best results were obtained for a groundwater discharge of 30 mgd and a dispersion coefficient of 0.7 m^2/s. Flushing time results show low variation with depth (STD about 0.1 days) and a mean flushing time of 0.53 days, which is about 12-13 hours as reported by Gallagher (1980). Increasing the dispersion coefficient to 0.8 m^2/s produced a smaller flushing time but also a thicker than observed top layer. Increasing the groundwater discharge or decreasing the dispersion coefficient moved the 29 ppt contour at the surface too far away from the harbor back wall.

The flushing time results calculated from the model simulated concentration for a groundwater discharge of 30 mgd and 0.7 m^2/s are presented in Table 3-3 at the same five stations reported by OI Consultants (1991) and at the top, middle and bottom of the water column. The full results of the calibration are displayed in Appendix B.

The groundwater discharge is meant only to represent a typical value. While it has been shown (Waimea Water Services, 2006) that the groundwater discharge into Honokohau Harbor varies with tides and seasonal rainfall events, this was not represented by the model.

Table 3-3: Flushing time (days) from the calibrated model 30 mgd and 0.7 m^2/s

	Station 1	Station 2	Station 3	Station 4	Station 5
Top	0.53	0.53	0.53	0.53	0.54
Middle	0.53	0.54	0.54	0.53	0.53
Bottom	0.52	0.52	0.52	0.49	0.52

In addition Figure 3-18 presents the salinity cross section across the harbor obtained from the calibrated model.

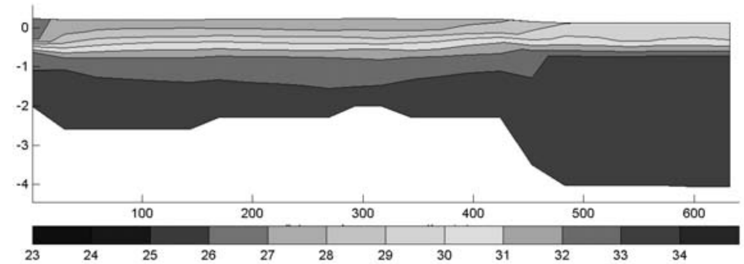


Figure 3-18: Simulated salinity contours (ppt) along Transect EH (Figure 3-12) at high tide –27 March 1991 for 30 mgd and 0.7 m^2/s

3.3 Future Conditions

The existing conditions model presented in the previous section was modified to include the Kona Kai Ola Marina. The future conditions model setup also considers possible brackish groundwater inflows mainly at the eastern side of the new basin. Additional inflows from the exhibit area of the development were included in the model as point sources. The uncertainty of the brackish groundwater inflow into the new Marina prompted a series of tests that examined a range of possible scenarios including the worst expected case. The purpose of this is to enhance the knowledge of the mechanisms controlling the hydrodynamic conditions of the new two-basin system, as well as to provide a range of possible conditions of the system.

The future conditions model was implemented following the same principles used for the existing conditions model described in the previous section. Offshore boundary conditions and bathymetry were kept the same. Conditions in the existing Harbor, including the brackish groundwater inflow were also kept the same. The new marina required additional parameters which are described in detail in the following sections.

3.3.1 Model Grid

The model grid developed in the previous section to simulate the existing conditions at Honokohau Harbor was extended to include the proposed area for the Kona Kai Ola Marina. Figure 3-19 shows the extent of the grid expansion. The offshore sections of the grid remained entirely unchanged. The grid extension does not encompass the area designated for the exhibit areas. These areas are included in the model as point sources of inflow.

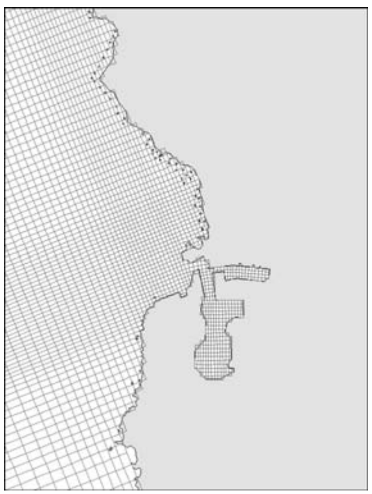


Figure 3-19: Model Grid Including the Kona Kai Ola Marina

3.3.2 Model Bathymetry

The same offshore and existing Harbor bathymetry used in the existing conditions model was also used in the future conditions model. The Kona Kai Ola Marina bathymetry and layout was built following the design plans included in the EIS. Figure 3-20 presents the future conditions model bathymetry.

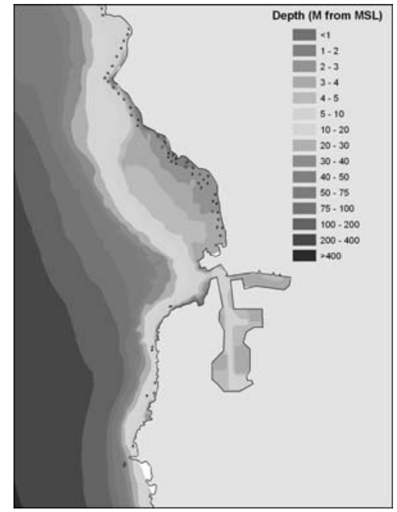


Figure 3-20: Model bathymetry including the Kona Kai Ola Marina

3.3.3 Model Boundaries and Additional Inflow into Kona Kai Ola Marina

Conditions at the offshore boundaries are the same described and applied in the existing conditions model. It is assumed that brackish groundwater discharge into the existing Harbor will remain the same after the construction of the new Marina. Additional inflows into the new Marina consist of discharges generated by the exhibit area and brackish groundwater inflow through the porous volcanic ground, mainly through the east wall of the new Marina. The exact value of this additional inflow is not known. In order to compensate for the unknown inflow, the model solution was bracketed between no flow conditions and twice the observed value under existing conditions (in addition to the present inflow). No flow conditions were analyzed in order to look at a control scenario which is suspected to be the worst case scenario in terms of flushing. A value of 30 mgd would represent persistence of the current conditions, since that it the value present in the existing marina and therefore it is considered a good starting point for analysis. Values of 15 mgd and 60 mgd represent a factor of two increase and decrease of inflow from the starting point. The simulated conditions are summarized in Table 3-4. A complete groundwater study would be needed in order to estimate with confidence the amount of brackish groundwater flow that would enter the new Marina. Other possible inflows into the new Marina such as the one associated with the SWAC air-conditioning system have not been considered in this study.

Table 3-4: Summary of tests used for description of future hydrodynamic conditions at the new Marina

Case 1	Brackish discharge = 0 mgd Exhibit discharge = 0 mgd
Case 2	Brackish discharge = 15 mgd Exhibit discharge = 0 mgd
Case 3	Brackish discharge = 30 mgd Exhibit discharge = 0 mgd
Case 4	Brackish discharge = 60 mgd Exhibit discharge = 0 mgd
Case 5	Brackish discharge = 0 mgd Exhibit discharge = 75 mgd
Case 6	Brackish discharge = 15 mgd Exhibit discharge = 75 mgd
Case 7	Brackish discharge = 30 mgd Exhibit discharge = 75 mgd
Case 8	Brackish discharge = 60 mgd Exhibit discharge = 75 mgd

Part of the flow that enters the new Marina from the exhibition area flows through three waterfalls and the rest is piped into the new Marina. This water is originally pumped from offshore at a depth of approximately 100 m with a flow rate of 75 mgd. The intake depth was selected to minimize the nutrient loads of the water (pers. comm. ClowardH2O, 2007). The water is then pumped to the exhibition area. The water is at an oceanic salinity (34 ppt) and has a temperature when withdrawn of approximately 3 ºC less than the surface water. Assuming that the pumping and subsequent movement through the exhibition area will serve to increase the temperature approximately 1 degree, it is assumed that the inflows to the new harbor are approximately at a temperature of 23 ºC (all assumptions and calculations with relation to the exhibit water were obtained from pers. comm. ClowardH2O, 2007). The water is expected to have an approximate 4 hour residence time within the exhibition area (pers. comm. ClowardH2O, 2007)

Brackish groundwater flowing into the new Marina is assumed to enter the basin only through the eastern side. The brackish groundwater inflow (15, 30, or 60 mgd) is equally distributed along all the grid points on that the eastern side of the Marina. In spite of the uncertainty associated with this assumption, mainly because some areas of the Harbor extension cut into the groundwater table further inland than others, it is considered to be a reasonable range of values to represent the system.

3.3.4 Flushing Under Future Conditions

The new Marina to be developed as part of the Kona Kai Ola Master Plan is much larger in volume than the existing Harbor. Table 3-5 shows the approximate volume of the existing marina and the new proposed one. Note that the volume of the new Marina does not include the

exhibit area, just the main basin. The Kona Kai Ola Marina is about 5 times larger (by volume) than the existing Harbor, and therefore, the combined system will have a volume six times the existing volume, while the connection to the ocean of the combined system will be maintained as today. The increase in flow into the system with the construction of the new Marina affects the Harbor mouth, primarily due to the increased new outflow from the new Marina. Therefore, the quantity of water that has to leave through the mouth of the combined system will increase from the existing conditions value as the inflows into the new Marina increase.

Table 3-5: Water volumes, from MSL, of existing and proposed marinas

Existing	3,936 m^3
Proposed	19,142 m^3

Flushing time is an important indicator of water quality, as it describes in this particular study the time that certain substance will remain in the harbor. The faster particles, pollutants, or algae flush out of the system, the less build-up there will be within the harbor, and the less chance there will be of major water quality problems like eutrophication and as stated by Ferreira *et al*. (2005), flushing is the primary means of maintaining water quality and biodiversity within a harbor. In previous sections, the flushing time under existing conditions was discussed. This section attempts to quantify the flushing time under a range of potential future conditions after the development of the Kona Kai Ola Marina. Eight cases were analyzed with four brackish groundwater inflow rates. While the exhibit area is a definite feature of the Conceptual Master Plan, its influence on the flushing time of the combined harbor system was assessed independently.

The flushing time was computed using the method outlined for existing conditions. The five stations described under existing conditions were also used in this analysis for the existing Harbor. These points coincide with those from the 1991 OI Consultants dye study. In addition, seven points were selected within the proposed new Marina. Each section of the Harbor was analyzed separately in order to determine the effects of the new Marina on each area. It is important to note however, that the entire system is treated as one system. Water flowing between the existing and new marinas is not considered to be flushed out to the ocean. Only "clean" water (ocean and brackish water inflows) from outside the system can flush the entire system. This is an important factor in the flushing time calculation of the entire system because as it is shown in later sections that there is a significant internal circulation between the two marinas. Rather than show the flushing time at each point, an average value for the entire Harbor section was computed. These average values are displayed in Table 3-6 and Table 3-7 for the existing and new marinas respectively.

Under existing conditions, the average flushing time of the existing Harbor was computed to be 0.53 days or 12.7 hours. After the addition of the new Marina to the system, the new flushing times for the existing Harbor under the highest brackish groundwater flow conditions simulated (60 mgd) increased to 19 hours. In general, for all the simulated cases, the area with the highest flushing times is the one at the back end of the new Marina. These flushing times were higher than 2 days in the case of no brackish groundwater discharge.

Table 3-6: Flushing times for the existing Harbor in days

Case	No Exhibit Flow	Exhibit Flow Included
Discharge 0 mgd	1.38	1.49
Discharge 15 mgd	1.11	1.10
Discharge 30 mgd	0.98	0.94
Discharge 60 mgd	0.86	0.83

Table 3-7: Flushing times for the Kona Kai Ola Marina in days

Case	No Exhibit Flow	Exhibit Flow Included
Discharge 0 mgd	2.39	1.72
Discharge 15 mgd	1.76	1.32
Discharge 30 mgd	1.44	1.09
Discharge 60 mgd	0.97	0.91

The simulated cases were designed to provide a range of solutions that span the possible post-expansion conditions. Since the flushing time decreases as the brackish groundwater inflow into the new Marina increases, the worst case scenario will be the one where the brackish groundwater inflow to the new marina is 0 mgd. The different brackish groundwater inflows simulated can be used to define an array of possible solutions, since the exact volume of groundwater is not known. A complete groundwater investigation would be needed to asses the quantity of brackish water entering the Harbor, although this value will not be known with certainty until the project construction is completed. However, from this analysis, it is seen that after construction of the new Marina, even with relatively high brackish groundwater inflow conditions (60 mgd in the new Marina and 30 mgd in the existing Harbor), it is not expected that the flushing time for the existing Harbor will decrease or even remain the same as under the current conditions. The results demonstrate that the flushing time is not only dependent on the volume of water entering the harbor system but also on the density driven circulation patterns associated with that addition. Given the new Marina basin is approximately five times the volume of the existing Harbor, even using the most optimistic scenario (brackish discharge of 60 mgd and a 75 mgd exhibit outflow, with a total = 5 times the 30 mgd used as inflow to the existing Harbor), the flushing time of the new Marina is 0.97 days which is significantly higher than the 0.53 days experienced under the current conditions.

It is also evident that while the 75 mgd of saline inflow coming from the exhibits does have a positive effect on the flushing time of the new Marina, the results indicate that this saline inflow does not have a significant effect on the existing Harbor's flushing. It is also apparent that smaller quantities of brackish water have more of an effect on the new Marina than does the saline inflow due to the density driven currents that result.

3.3.5 Circulation under Future Conditions

Model results indicate that circulation within the existing Harbor will be modified by the addition of the new Marina. While there is still a well defined two-layer system with a seaward-moving surface layer of brackish water. This surface layer is diverted into the more saline new Marina.

Currents within the new Marina develop into a complicated system. Figure 3-21 through Figure 3-24 show a cross section (Transect NM, Figure 3-12) along the center of the new Marina from south to north (the back wall of the new Marina is located at the left side of the figures) with contours of the velocity in m/s. At lower brackish groundwater inflow rates, the vertical distribution of salinity and velocities in the new Marina consists of three distinct layers (Figure 3-21, Figure 3-23). The top layer is flowing into the harbor with low density water from the existing Harbor. The bottom layer is high salinity oceanic water flowing in from the mouth. The middle layer is flowing out of the new Marina as the higher density oceanic water pushes it up and out of the existing Harbor and new Marina system.

With higher brackish groundwater inflows, the system approaches a two layer system (Figure 3-22 and Figure 3-24) closer to the one observed in the existing Harbor. The surface inflow from the existing Harbor is reduced and does not penetrate into the new Marina as much as observed under lower brackish groundwater inflow conditions.

The impact of the 75 mgd inflow from the exhibits into the new Marina could be estimated by comparing the simulation results without the inflow (Figure 3-21 and Figure 3-22) and those with the inflow (Figure 3-23 and Figure 3-24). Simulation results show that the density driven circulation is reduced when the exhibit inflow is included, since the water in the new Marina becomes more saline.

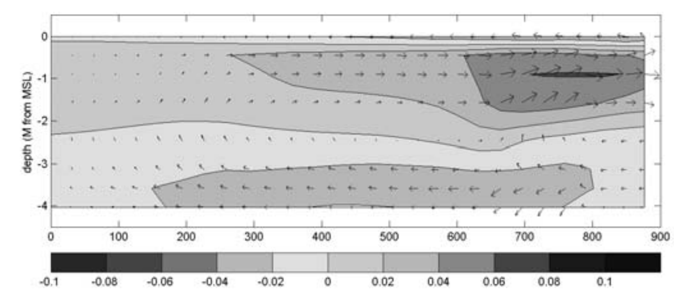


Figure 3-21: Currents at peak flood (m/s) along Transect NM (Brackish discharge of 0 mgd)

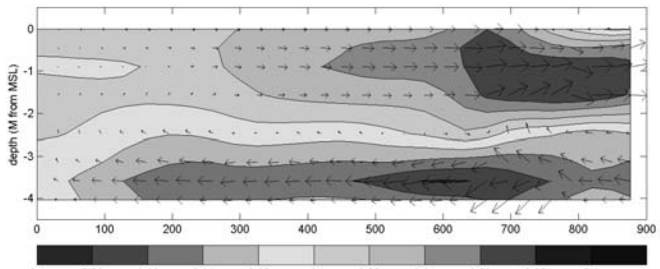


Figure 3-22: Currents at peak flood (m/s) along Transect NM (Brackish discharge of 60 mgd)

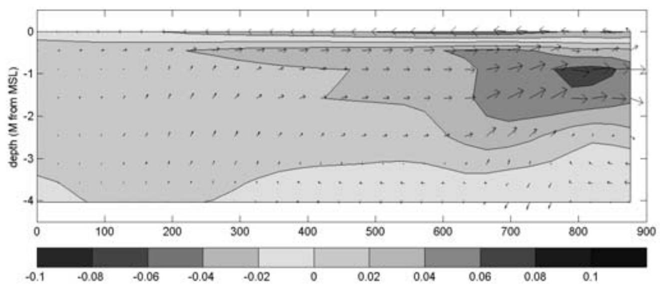


Figure 3-23: Currents at peak flood (m/s) along Transect NM (Brackish discharge of 0 mgd and exhibit discharge of 75 mgd)

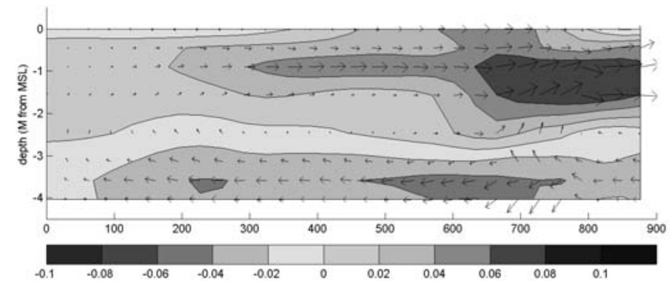


Figure 3-24: Currents at peak flood (m/s) along Transect NM (Brackish discharge of 60 mgd and exhibit discharge of 75 mgd)

Currents at the mouth of the harbor system (harbor mouth, Figure 3-12) are also affected by the increase in flow from the new Marina. Figure 3-25 and Figure 3-26 show how the velocity profile varies at the harbor mouth for flood and ebb tides under different brackish groundwater inflow conditions at the new Marina and also with the additional inflow from the exhibits. The most significant change with respect to existing conditions is observed during ebb flow, when, for the cases with low brackish groundwater inflow into the new Marina, the deep dense water layer moving into the Harbor is canceled. Under these conditions, the water is moving seaward at all depths in the water column, with a significant increase of the surface currents with respect to existing conditions. This effect during ebb flow is more pronounced when the inflow from the exhibit is included in the simulations (see Figure 3-26). During flood flow, the two-layer system observed under existing conditions is maintained, though the magnitude of the velocity at both layers increases.

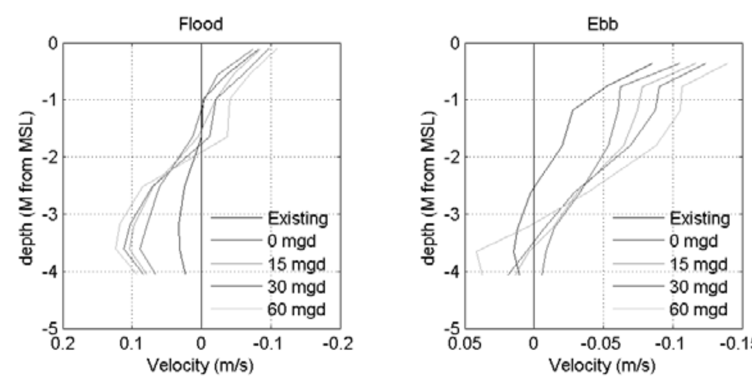


Figure 3-25: Velocity profiles at harbor mouth for 0 mgd exhibit flow

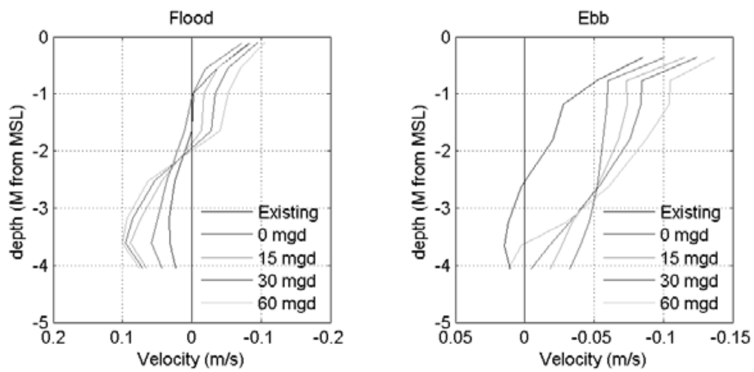


Figure 3-26: Velocity profiles at the harbor mouth for 75 mgd exhibit flow

3.3.6 Salinity

Salinity distribution in the new Marina is controlled by several different sources: the saline ocean water from the exhibits (75 mgd), brackish groundwater inflows, and the exchange between the existing Harbor (surface brackish water) and the ocean (bottom saline water). The vertical salinity distribution along a central cross-section of the new Marina for the simulations with low brackish groundwater inflow shows a very small variability in salinity with a small area of brackish water at the surface near the harbor entrance. Figure 3-27 and Figure 3-29 show the salinity contours for the cases with 0 mgd brackish groundwater inflow. Results from these simulations show high salinity concentrations at the far end of the Harbor in the range of 31 to 33 ppt. Overall, in these cases, the salinity within the new Marina remains higher than that in the existing Harbor. Figure 3-28 and Figure 3-30 show the salinity contours along transect NM (Figure 3-12) for the cases with 60 mgd brackish groundwater inflow. These cases show much more brackish water in the surface layers with saline water being confined to the bottom layers. It is observed in Figure 3-29 and Figure 3-30 that including the 75 mgd inflow of 34 ppt water from the exhibits reduces the stratification and increases the salinity concentration in the new Marina.

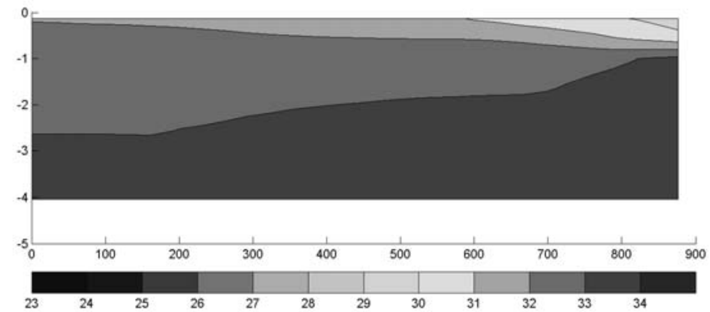


Figure 3-27: Salinity contours at flood tide (ppt) along Transect NM (Brackish discharge of 0 mgd)

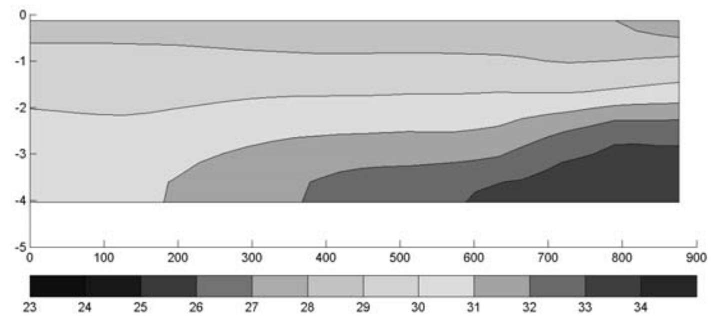


Figure 3-28: Salinity contours at flood tide (ppt) along Transect NM (Brackish discharge of 60 mgd)

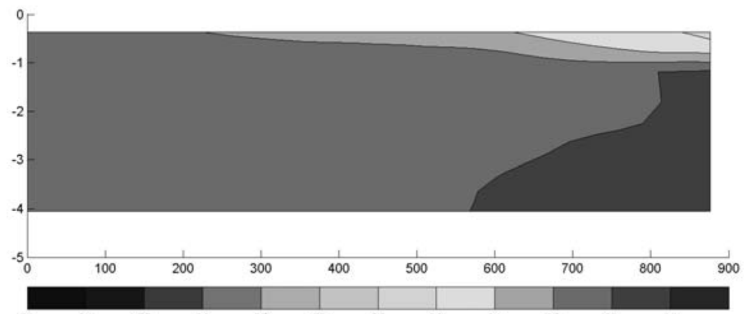


Figure 3-29: Salinity contours at flood tide (ppt) a along Transect NM (Brackish discharge of 0 mgd and exhibit discharge of 75 mgd)

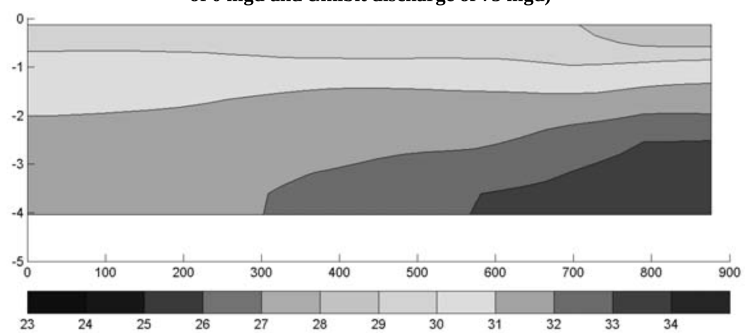


Figure 3-30: Salinity contours at flood tide (ppt) along Transect NM (Brackish discharge of 60 mgd and exhibit discharge of 75 mgd)

Salinity patterns within the existing Harbor are also altered under future conditions due to the change in circulation. Circulation between the two marinas impacted the existing Harbor decreasing its water exchange with the ocean significantly. This was already evident after examining the significant change in flushing times presented in Section 3.3.4. Figure 3-31 and Figure 3-33 show the net salinity changes along Transect EH (Figure 3-12) with 0 mgd of brackish groundwater inflow into the new Marina. In this case changes are small and limited to the region where the two marinas connect. In this region, the salinity in the surface layer slightly increases because the low salinity water in the top layer flows into the new Marina instead of towards the ocean. Figure 3-32 and Figure 3-34 show the net tidally averaged salinity changes along Transect EH associated with the simulated conditions brackish groundwater inflow of 60 mgd into the new Marina. In these cases, the salinity concentration throughout the whole existing harbor is significantly reduced. This is probably a consequence of the new circulation

patterns of the combined system, where the brackish layer flowing out of the new Marina flows into the existing Harbor under the existing fresher water of the surface, blocking denser ocean water from moving into the bottom layer of the existing Harbor. As a consequence, dense ocean water flows through the bottom layer into the new Marina under the exiting brackish water. The addition of the 75 mgd of saline water coming from the exhibits reduces this effect since the flow out of the new Marina is then slightly more saline. Therefore the reduction in salinity in the existing Harbor is less pronounced.

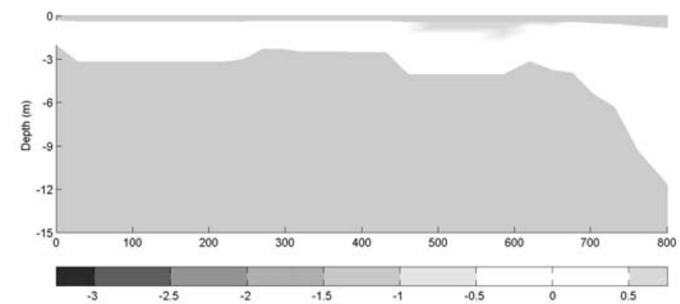


Figure 3-31: Salinity change (ppt) along Transect EH (Brackish discharge of 0 mgd)

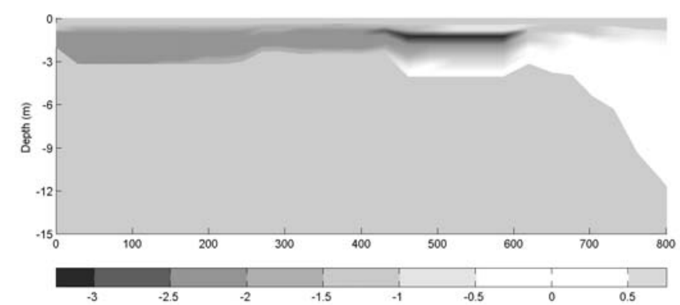


Figure 3-32: Salinity change (ppt) along Transect EH (Brackish discharge of 60 mgd)

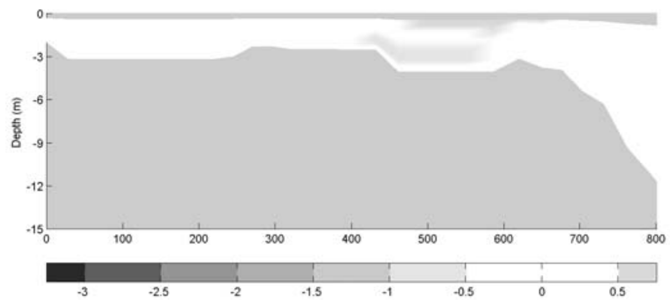


Figure 3-33: Salinity change (ppt) along Transect EH (Brackish discharge of 0 mgd and exhibit discharge of 75 mgd)

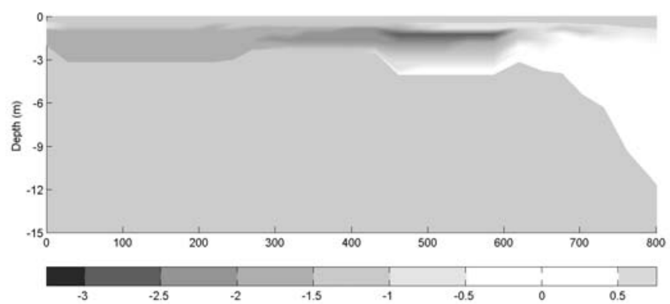


Figure 3-34: Salinity change (ppt) along Transect EH (Brackish discharge of 60 mgd and exhibit discharge of 75 mgd)

In order to further investigate the effects of the water circulating through the two marinas, the salinity profiles at the intersection of the new Marina and the existing Harbor (intersection, Figure 3-12) are shown in Figure 3-35. It is seen that as the quantity of brackish groundwater in the system increases, the well defined two-layer system present under existing conditions changes into a vertical distribution of salinity, which is almost linear over depth. This is observed for both cases with and without the 75 mgd of saline inflow from the exhibits, though the salinity through the middle to bottom layers is slightly more saline when the inflow from the exhibit is included.

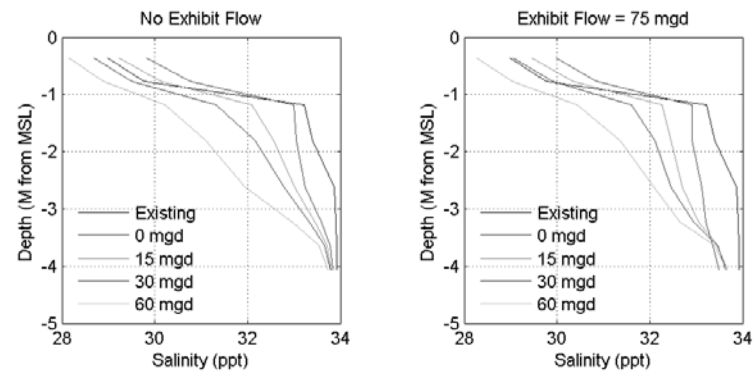


Figure 3-35: Salinity profiles at the intersection of existing and extended harbor

4. WATER QUALITY MODEL

The water quality module, Delft3D WAQ, simulates two-dimensional (2D, depth averaged) or three-dimensional (3D) transport and physical, biological and biochemical phenomena for a variety of model substances. The physical transport is governed by the advection-diffusion-reaction equation which is discretized for each computational cell. The physical transport is dependent on physical position, as is described in the hydrodynamic module. In addition to physical transport, Delft3D WAQ implements the biological and chemical reactions that affect each modeled constituent. This represents the complexity of interactions between substances and processes, which are independent of spatial position.

Delft3D WAQ is based on a flexible interface that allows the user to define the processes and components that are included within the model. The equations governing the processes for each substance are coupled together, giving a fully integrated water quality model. Given this, the computational time for the model increases with both the number of modeled substances and the complexity of the interactions. Process coefficients are defined within the model and are easily changed for calibration and sensitivity purposes. Initial and boundary conditions for the modeled substances can be defined within the model.

The model developed for Honokohau Harbor is necessarily site-specific. The substances and processes chosen for modeling are the ones most important to the overall water quality of the Harbor. The main goal of the study is to analyze the potential changes in water quality associated to the addition of the Kona Kai Ola Development including the new Marina and water exhibits. Therefore, it is important to develop a model to simulate the existing water quality conditions that can easily be extended to include the new developments. Of particular importance within the harbor are the aerobic conditions that are consistently observed in the existing Harbor. Modeling efforts presented here include the simulation of the existing conditions, and they also attempt to quantify the predicted changes to occur after the construction of the new development.

The kinetics that were implemented in the Delft3D-WAQ module were designed to predict the typical phytoplankton production in addition to this population's relation to the nutrient supply and the overall effect on the supply of oxygen within the water column. The model was designed to incorporate daily variation and seasonal variation; however, the data available did not provide seasonal or even daily variation. So the model was designed to predict an average value that was in line with the available data. This value is considered to be typical and this typical value is sufficient for the purposes of predicting the effects of the new development.

The substances used to quantify these conditions within the harbor are shown in Table 4-1. These values were chosen based on available data for input conditions and calibration (OI Consultants, 1991 and Ziemann, 2006). The interactions of the variables are described in detail in the following sections.

Table 4-1: Modeled substances

Phytoplankton	Diatom chlorophyll a
	Non-diatoms (green algae) chlorophyll a
Zooplankton	Herbivorous zooplankton
Nitrogen	Nitrate-nitrogen
	Ammonium-nitrogen
Phosphorous	Reactive phosphorous (ortho-Phosphate)
Silica	Reactive silicate
Oxygen	Dissolved oxygen

4.1 Model Grid and Hydrodynamics

The physical transport mechanisms necessary to drive the advection-diffusion equation are determined from the hydrodynamic model using Delft3D-FLOW. Hourly hydrodynamic updates were passed to the water quality model. The results of the hydrodynamic conditions were discussed and presented in the previous sections. The hydrodynamic results computed by Delft3D-FLOW were used to drive the water quality model. These hydrodynamics were coupled such that the Delft3D-WAQ module could easily derive the flow field and other parameters such as salinity and water temperature at each hydrodynamic time step. The model grid used for the hydrodynamic computations was also used for the WAQ model. The three-dimensional model grid was described in the hydrodynamic modeling section of the report. The vertical model discretization in 8 vertical layers allows for the simulation of the vertical variation in water quality parameters. Due to the complexity of the flow fields generated in Honokohau Harbor, this three-dimensional distribution is essential to understanding the water quality issues within the Harbor and surrounding areas. Horizontal dispersion was calibrated within the hydrodynamic model, and vertical eddy diffusion coefficients in the water quality model were computed by the hydrodynamic model using a k-ε turbulence closure scheme.

4.2 Temperature and Salinity

The biological elements (phytoplankton) present in the Harbor are strongly influenced by the temperature and salinity variation. The temperature dependency of the reaction rates has a uniform exponential equation.

$$k = k^{20} x k_T^{(T-20)}$$

k is the rate constant at some arbitrary temperature, T. The reference temperature for Delft3D-WAQ is considered to be 20 degrees Celsius, and k^{20} is the rate constant at this temperature. k_T is the temperature coefficient, which usually ranges between 1.01 and 1.10.

Temperature was determined within the Delft3D-FLOW hydrodynamic model. It included a heat-flux model taking into account air temperature, a typical wind speed and percent cloud cover. Evaporation and conduction were also included in the computation. Solar radiation was implemented within the Delft3D-WAQ model and controlled the quantity of light penetrating the water column.

Similarly to temperature, salinity variation has an effect on the biological and chemical reactions occurring within the Harbor. Salinity is also extracted from the hydrodynamic computation and is used to force the water quality model. Both salinity and temperature effects on the flow field are neglected within the water quality module as they were calculated within the hydrodynamic model. In fact, there is no feedback from the water quality module to the hydrodynamic module, and therefore none of the substances within the water quality module can affect or modify the flow field generated by Delft3D-FLOW.

4.3 Dissolved Oxygen

Dissolved oxygen (DO) is often taken as a representation of the health of a water body. Low values of DO indicate that the water is not able to sustain aerobic conditions and that the demand for oxygen exceeds the supply. The sources of DO within the water column come from reaeration at the water surface–air interface and the production of oxygen by phytoplankton during growth. Oxygen is utilized during nitrification, carbon decay, and respiration of both phytoplankton and zooplankton.

If the DO concentration is greater than the saturation concentration (supersaturation) at that temperature and salinity, the water will release oxygen to the atmosphere; however, if the water is undersaturated, then the water will take on oxygen from the atmosphere through reaeration. Stratification within the water column can cause significant water quality problems as the hypolimnion is not in contact with the atmosphere and cannot replenish the oxygen concentration from the atmosphere.

The only chemical reaction utilizing oxygen that is incorporated by Delft3D-WAQ in the Harbor simulations is the reaction converting ammonium to nitrate, which is discussed in Section 4.4. In addition, Deflt3D-WAQ contains the capacity to include collective parameters that indicate oxygen demand, such as Chemical Oxygen Demand (COD), or Biological Oxygen Demand (BOD) in order to encompass other processes and sources of demand that are not explicitly present within the model (WL| Delft, 2004). Available data on the oxygen demands on the system aside from nitrification were not available, and were not included in the model.

Phytoplankton respiration occurs during both day and night; however, primary production only occurs during the daylight hours, when photosynthesis can take place. Therefore, there is generation of oxygen occurs only during the day, while only consumption can occur at night. Due to this, there will be lower DO Oxygen values during the nighttime.

4.4 Nitrification

From a modeling perspective, nitrogen is difficult to model due to its loading pathways. In addition to the varying nitrogen species created from varying degrees of oxidation, loading may result from nitrogen-fixing bacteria and algae utilizing atmospheric N_2 gas directly to satisfy photosynthetic nitrogen requirements (when nitrogen is limited in the water column) or from bacterial conversion of organic nitrogen to NH_4-N at the sediment water interface. Nitrogen losses may occur due to denitrification (anaerobic conversion of organic nitrogen to N_2 gas) in the reducing environment found in the sediment-water interface. Additionally, nitrogen is generally identified with the dissolved water column constituents and cycles easily throughout the water column.

One of the significant sources of oxygen demand within a system is the nitrification of ammonium to nitrate. When a high ammonium loading comes from sewage or fertilizers, the

oxygen demand can be extremely problematic to these water systems. Ammonium in aerobic conditions is oxidized to nitrite by the bacteria Nitrosomonas.

$$NH_4 + 1.5O_2 \rightarrow 2H^+ + H_2O + NO_2^-$$

The nitrite formed is then oxidized to nitrate-nitrogen by the bacteria Nitrobacter.

$$NO_2^- + 0.5O_2 \rightarrow NO_3^-$$

Therefore the total oxygen utilization in the oxidation of ammonium is 4.57 g-oxygen per g-ammonia-nitrogen. In order for this process to commence, the conditions must be aerobic (DO>2.0 mg-O_2/L), o-P must be present, and the environment must be alkaline with a pH between 6.0 and 8.5.

The oxygen consumption due to the nitrification of ammonium is proportional to a nitrification rate (obtained from EPA: Lake Erie Model (1980)) and a function of the DO and ammonium concentration. If the system becomes anaerobic, denitrification takes place, although within Honokohau Harbor, this condition is not applicable.

4.5 Phytoplankton

Phytoplankton are non-motile, plant-like bacteria, which similarly to plants only grow, and thus release oxygen, in the presence of light. If phytoplankton are present in large quantities, they can consume the oxygen within the system through respiration and cause the system to become eutrophic. Phytoplankton growth is limited by the presence of consumers (zooplankton) and the availability of nutrients within the system. In Honokohau Harbor, two types of phytoplankton are considered, diatoms and non-diatoms (green-algae). Only two types were chosen for modeling due to the availability of only Chlorophyll a concentration values, so a sophisticated species specific model is unreasonable given the calibration data. A “typical” ratio of 25 mg-CHLa to 1g-C for phytoplankton (Chapra 1997) was used to convert between carbon and chlorophyll for the purposes of the model inputs. Diatoms and non-diatoms are differentiated only by the diatom’s silica requirement. The cell wall of the diatom is made up of silica and if there is a bloom of diatoms, a depletion of silica within the system would be noticeable. The stoichiometric composition of the diatom and the typical green algae (classical ratios for O:C:N:P (109:41:7.2:1) is similar in proportion neglecting the silica (Chapra, 1997).

Growth, or primary production, occurs during daylight hours and requires that there be enough nutrients present. The typical growth rate of maximum production was obtained from EPA: Lake Erie Model (1980). Nutrient dependency relates the growth rate of the phytoplankton to the external nutrient concentrations. Phosphorous, nitrogen, carbon, and silica (for diatoms) are the potential limiting factors, although in most models, carbon is not assumed to ever limit growth (Chapra, 1997). Delft3D-WAQ utilizes a model for primary production using Monod-type kinetics for the calculation of growth rates. Primary production is proportional to the biomass concentration and the gross primary production (growth) rate. The consumption of inorganic nutrients and production of DO is proportional to the net primary production (WL| Delft, 2004).

In order to determine the limiting nutrient for phytoplankton growth, the N:P ratio is used. The ratio of nitrogen to phosphorous in the biomass of phytoplankton is roughly 7.2 (Chapra, 1997). Therefore, a ratio in the water of less than 7.2 indicates that nitrogen is the limiting factor.

Conversely, higher ratios indicate that phosphorous will limit growth. In the case of Honokohau Harbor, the ratio of N:P in 1991 was approximately 6 which would make the system nitrate-nitrogen-limited. This was also the case pre-expansion (Bienfang, 1980). In 2006, the data presented by Ziemann shows the system o-P to be lower in concentration at all depths than in earlier studies (Bienfang, 1980 and OI Consultants, 1991) and the system appears to have become phosphorous-limited. This might imply that phosphorous loading has changed, since the groundwater ratios of NO_3-N to o-P remain fairly constant. The limiting factor has a significant impact on phytoplankton growth and is important to consider. Due to the apparent shift in limiting nutrients, the difficulty in calibrating the model between the two datasets is evident in later sections of this report.

For the purposes of this model, biological and chemical interactions with the sediment layer were neglected; however, the settling of phytoplankton is important and typical settling velocities were obtained from Burns and Rosa (1980) and from EPA: Lake Ontario Model (1975). The settling of phytoplankton only occurs when the bottom shear stress, computed in the hydrodynamic model, drops below a critical value. Dead phytoplankton are converted to inorganic nutrients, and the mortality is controlled by the biomass concentration and a mortality constant, which was obtained from EPA: Rates, Constants and Kinetics (1985).

4.5.1 Primary Consumption

The presence of primary consumers such as zooplankton can significantly impact the phytoplankton population in a system. This model accounts for the first level of consumers, the herbivorous zooplankton, however carnivorous zooplankton and higher levels of consumers were not included within the model. While the respiration of zooplankton has an effect on the DO content within the water column, this effect is ignored in Delft3D-WAQ (WL|Delft, 2004). The stoichiometry of the primary consumers is defined, and generally is considered to be related to the composition of their food supply. The uptake rate of phytoplankton biomass for food, respiration and mortality of biomass, and excretion of nutrients are included in the model (values obtained from EPA: Rates, Constants, and Kinetics, 1985). Concentrations of zooplankton were reported in OI Consultants (1991) and Bienfang (1982).

4.6 Model Conditions

The model was set up using Delft3D-WAQ which is a three-dimensional numerical model with the capacity for multiple substances and varying processes. The processes and substances included in the model set up were described at length in the previous section. The hydrodynamic conditions used to drive the water quality model were discussed at length in Section 3. The water quality model was developed to fit the processes and specifics of Honokohau Harbor under existing conditions. It was calibrated to data collected in 1991 (OI Consultants, 1991) and verified using data collected in 2006 (Ziemann, 2006). The proposed expansion of the Harbor was analyzed using the calibrated and validated numerical model to describe the changes that are expected to occur with the extension of the harbor and the additional loads associated with this new Marina.

The grid and bathymetry used for the water quality module were the same as those presented in the hydrodynamic section. Seasonal variability in the water quality model was not considered since such information was not available for calibration and therefore the model was

implemented under "typical conditions." A spring-neap tidal cycle was simulated; however, the model was calibrated to an average value and not to daily or tidal variability. In addition, neither variations in brackish water inflows nor variations in nutrient loadings were considered in the model. Daily variation was considered to the extent that phytoplankton do not grow without the presence of sunlight.

In order to drive the water quality model, conditions for all modeled constituents had to be specified at the initial time in addition to specifications at each boundary and inflow. The oceanic conditions shown in Table 4-4 were applied to every cell within the model as initial conditions. These conditions were also used at the offshore boundaries. The offshore boundaries were sufficiently far enough away from the site that the boundary conditions at the boundary have no immediate direct effect on the site conditions.

Initial and boundary conditions for the model were taken from site specific data sources when possible and supplemented with appropriate literature values. All of the initial and offshore boundary conditions were taken from the offshore transect data collected by Ziemann (2006). The transect data was taken over three days and at two depths: near the surface and near the bottom. The furthest point along all transects was 500 m from the shoreline (Table 4-2). This point was selected to represent the offshore conditions for the numerical model (Table 4-4)

Table 4-2: Offshore statistics (Ziemann, 2006 – 500 m from shore)

	Dissolved Oxygen (mg/L)	Silica (µg-Si/L)	Ortho-Phosphate-phosphorous (µg-P/L)	Nitrate-nitrogen (µg-N/L)	Ammonia-nitrogen (µg-N/L)	Chlorophyll a (µg/)
Mean	7.13	312.87	2.967	21.13	1.430	0.210
Standard Error	0.05	65.12	0.162	4.34	0.197	0.030
Median	7.14	172.50	3.000	14.00	1.100	0.145
Mode	7.05	173.00	3.000	5.00	0.500	0.130
Standard Deviation	0.29	356.70	0.890	23.75	1.077	0.166
Minimum	6.54	68.00	2.000	3.00	0.500	0.090
Maximum	7.94	1869.00	6.000	120.00	4.400	0.700
Count	30.00	30.00	30.00	30.00	30.00	30.00
Confidence Level (95.0%)	0.11	133.20	0.332	8.87	0.402	0.062

The selected offshore conditions were applied as the constant offshore boundary and also as initial conditions for the model. In order to convert the Chlorophyll a concentration to concentrations of diatoms and algae respectively, the ratio of 1:20 for diatoms to algae was used, which was consistent with data obtained by Brix *et al.* (2006) for their study in central Pacific waters. In addition, the typical value of 25 µg-CHLa/L to 1 mg-C/L (Chapra, 1997) was used to convert the measured data to model inputs and vice versa.

Data was also needed to provide the conditions for the brackish water inflows entering the system at the back of the Harbor. Several studies were conducted with respect to groundwater conditions in Honokohau Harbor. Waimea Water Services, Inc. (2006) published a report on the state of the groundwater and brackish water flowing into Honokohau Harbor. Cited in this report is the water chemistry from the project area that was collected in the 1996 study of the discharge from the Kealakehe wastewater treatment plant. This data was analyzed by AECOS Laboratories, Hawaii. Samples were collected from the Visitor Center, Quarry, Well #2 and Well #6 using a peristaltic pump to prevent contamination. This program revealed that the natural groundwater in the Quarry well (upfield of the Harbor) has higher nutrient loads than the water entering the Harbor (Harbor Spring) indicating that tidal mixing is diluting nutrient loads.

Three groundwater wells were installed by the USGS in 1996. These wells were located inland of Aimakapa pond, inland of Kaloko Pond, and inland of and between the two ponds. These wells were used for water quality sampling on five separate occasions (Oki *et al*., 1999; Brock and Kam, 1997; Nance, 2000; Tribble, 2003; and Bienfang, unpubl.). Using these five sets of data, Hoover and Gold (2005) developed the nutrient vs. salinity curves shown for all three wells. These curves show a fairly constant relationship of salinity with nitrate, phosphate, ammonium and silica and fairly good agreement among the five sets of collected data. Using this relationship an inference of nutrient values for the salinity of the brackish inflow to the Harbor can be obtained.

In addition to this study, Johnson *et al*. (2006) presented similar curves of nutrients vs. salinity and also found a linear relationship with the exception of nitrate, which they assumed to be exponential. For the purposes of this analysis, a linear relationship is used for all nutrients as was described in Hoover and Gold (2005).

A comparison of values derived from these recent data sets were checked against each other. Note, however, that the values obtained from Hoover and Gold (2005) and Johnson *et al*. (2006) were estimated from the graphs and that the NO_3-N curve from Johnson *et al*. (2006) were linearized for the purposes of this analysis. In addition, chemical analysis of the groundwater by Bienfang (1980) indicates that it has a NO_3-N concentration of 35.7 µg-atom/L and a o-P concentration of 2.4 µg-atom/L.

The concentration of nutrients within the groundwater are quite high (Bienfang, 1980), and the tendency of Honokohau Harbor would be towards eutrophication. This is only prevented by the high rate of flushing which is 87% faster than the calculated tidal flushing (3.2 days) (OI Consultants, 1991). Bienfang (1980) also noted Honokohau Harbor's "isolation from other affecting forces, such as run-off, river/stream, or domestic/industrial sewage inputs." This indicates that the nutrient loads within the groundwater entering Honokohau Harbor originate upland of the WWTP. A simple analysis in Appendix C evaluates pathways of WWTP effluent through the ground.

Table 4-3: Groundwater conditions from four sources

	AECOS (2006 Harbor Spring)	Hoover and Gold (2005) (22 ppt)	Johnson *et al*. (2006) (22 ppt)	Bienfang (1980)
NO_3-N	420 µg-N/L	336 µg-N/L	434 µg-N/L	499.8 µg-N/L
PO_4-P	-	46.5 µg-P/L	58.9 µg-P/L	74.4 µg-P/L
NH_4-N	3 µg-N/L	14 µg-N/L	-	-
SiO_2-Si	15,800 µg-Si/L	8,960 µg-Si/L	8,960 µg-Si/L	-

From Table 4-3 it can be seen that the values collected and extrapolated from fitted curves are all similar in quantity and magnitude. A first test indicated that the values from AECOS (Waimea Water Services, Inc. 2006) were reasonable in terms of model performance, but that NH_4-N levels remained too small. Therefore, the value of incoming NH_4-N was increased to the value reported by Hoover and Gold (2005).

Table 4-4: Offshore and Groundwater Conditions

Constituent	Offshore condition	Groundwater Condition
Nitrate-nitrogen (NO_3)	21.13 µg-N/L	420 µg-N/L
Phosphate-phosphorous (PO_4)	2.97 µg-P/L	60 µg-P/L(lower)
Algae(non-Diatom)	0.008 mg C/L	0 µg/L
Diatom	0.0004 mg C/L	0 µg/L
Dissolved Silicon	312.87 µg-Si/L	10,000 µg-Si/L
Ammonia-nitrogen (NH_4)	1.43 µg-N/L	14 µg-N/L
Dissolved Oxygen	7.13 mg/L	4 mg/L

While there may be other nutrient loads to the system, it was beyond the scope of this model to be able to predict or calibrate to unknown loads. The incoming brackish groundwater parameter that was estimated or calibrated to the model was DO. The DO concentration was not reported by Waimea Water Services (1996), and measurements displayed in Hoover and Gold (2005) show a range of values of 5 to 8 mg-O/L. Bienfang (1980) reported values for DO of about 5 mg-O/L at the back of the basin, and so it is reasonable to use a lower concentration than 5 in the brackish water flowing from the back of the basin.

4.7 Existing Conditions

The water quality within Honokohau Harbor has been shown in previous studies (Ziemann, 2006 and OI Consultants, 1991) to be quite good. This is primarily attributed to the high rate of flushing within the Harbor. While in earlier years, water quality within the Harbor was affected by bilge discharges from boats, wastewater additions and other pollutants, the conditions currently seem to indicate that those sources have been decreased if not eliminated. The phosphorous loads on the system have apparently decreased between 1991 (OI Consultants, 1991) and 2006 (Ziemann, 2006). This is corroborated by the increase in the N:P ratio from approximately 6 to more than 15, indicating either a decrease in phosphorous loading or an increase in uptake by the resident algal population. An additional observation from all the datasets was a general decrease in concentration of nutrients at mid-Harbor, indicating a change in volume/bathymetry at approximately the location of the Harbor expansion (Phase I). An increase in nutrients near the Harbor mouth at approximately sampling station 7 (Ziemann 2006) tends to indicate an unidentified source. These broad conclusions about the change in water quality should be carefully considered because the data collected by Ziemann (2006) contains only one sample that may or may not represent a broad view of current conditions within Honokohau Harbor.

In order to calibrate the model to existing conditions, the calibration data points had to be determined. While the most recent data are preferable as descriptors of current conditions, the data were limited to one sample at each point. The less recent OI Consultants dataset (1991) was taken over a three month period with six total sets of data. This dataset was chosen, if only due to more reliable "typical" conditions. The 2006 data are used to provide additional verification as to the model's ability to predict these "typical" conditions. While the conditions and limiting nutrient may have changed since 1991, the trends and order of the model results are still reasonable.

Calibration of the model was performed with six different constituents ("benchmarks"): Silica (Si), NO_3-N, NH_4-N, o-P, DO, and Chlorophyll a. Due to the similarity of the station locations in 1991 and 2006, it was possible to compare some stations simultaneously with the model results. In these cases, the figures are labeled with Station 1/A, which indicates that the comparison is with Ziemann (2006) station 1, and OI Consultants (1991) Station A. The station locations are shown in Figure A-1 and Figure A-3 for Ziemann (2006) and OI Consultants (1991) respectively. However, a direct comparison is precluded because the surface samples were taken at differing depths.

The model used a certain amount of time to "spin up" or achieve quasi-steady state solutions to all of the processes involved. After this time period, which was about 10 days, the values of the model were extracted and averaged over the rest of the model run. Each model was run for a 1 ½ month period. The resulting means and standard deviations are compared to the geometric means of the OI Consultants (1991) datasets and the values obtained by Ziemann (2006). Note that the model standard deviation is only representative of the daily and tidal variability. OI Consultants (1991) took samples at three depths; however, due to changes in bathymetry or conditions on the day of sampling, some of the depths are below the model depth which is zero at MSL. Points which are not displayed fell outside the range that is shown on the figure. These points represent either aberrations in data or inability of the model to predict the large sample

variability. Average model results are shown as black solid lines, with the standard deviation shown as a dotted line. OI Consultants (1991) geometric mean data is shown as red circles, while Ziemann (2006) data is shown as blue circles. Ziemann (2006) took data points at 0.3 m from the surface and 0.5 m from the bottom (at unspecified tidal cycles) while OI (1991) sampled at 0.5 m from the surface, 1.5 m and 3.0 m from the surface for ebb and flood tides.

4.7.1 Silica (Si)

Silica concentrations within Honokohau Harbor changed between 1991 and 2006. The values obtained in 2006 are higher than those collected in 1991. This is especially evident in the surface layer. Figure 4-1 shows the calibration for the silica model results and data. The model performed well by correctly simulating the vertical distribution and magnitude of the depth variability; however, the differences between 1991 and 2006 were too extreme to be captured by the model. Similarly to the other nutrients discussed in the following sections, silica is present in high quantities in the upper layer throughout the existing Harbor .Silica concentrations were highest at the back of the Harbor and decreasing toward the mouth, establishing groundwater as the loading source. The lower layers tend to have either more "clean" sea water or more diatoms that consume the silica. Therefore, concentrations in these layers tend to be less. However, the concentrations of silica in the Harbor increased significantly from 1991 to the 2006 measurements. This would tend to imply a shift in the algal populations away from silica consumers (diatoms), co-incident with the overall system shift from nitrogen-limited to phosphorous-limited.

4.7.2 Nitrate-nitrogen (NO_3-N)

NO_3-N concentrations within Honokohau Harbor also changed between 1991 and 2006. This is indicated by the apparent system shift from nitrogen-limited to phosphorous-limited, leaving excess inconsumable NO_3-N. However, the values are not very different. They are still within the same order of magnitude, and the model matches that magnitude along with the vertical distribution (Figure 4-2). Higher NO_3-N concentrations are found in the surface layer, where there are fewer phytoplankton to consume it. Deeper in the water column, more phytoplankton are present due to slower velocities and warmer temperatures. Stations closer to the Harbor entrance have a more drastic vertical distribution due to the influx of "clean" sea water in the lower layers and the high nutrient brackish water in the upper layers. Again, there is an apparent decrease in concentration in surface samples mid-Harbor (possibly indicating a change in volume or bathymetry that would dilute the load of NO_3-N) and an increase near the mouth (indicating an unidentified source at that location).

4.7.3 Ortho-phosphate (o-P)

The axial and vertical distribution of o-P follows the trends of both nitrate-nitrogen and silica, since it is subject to similar effects. Concentrations were higher in surface samples at the back of the Harbor and generally become lower due to dilution and consumption. A spike in concentration near the Harbor mouth (Ziemann (2006) station 7) implies an additional and unidentified load is entering near the Harbor mouth. The model performs well in replicating this distribution. The o-P concentrations are significantly lower in 2006; however these levels are still within the same order of magnitude of the values collected in 1991.

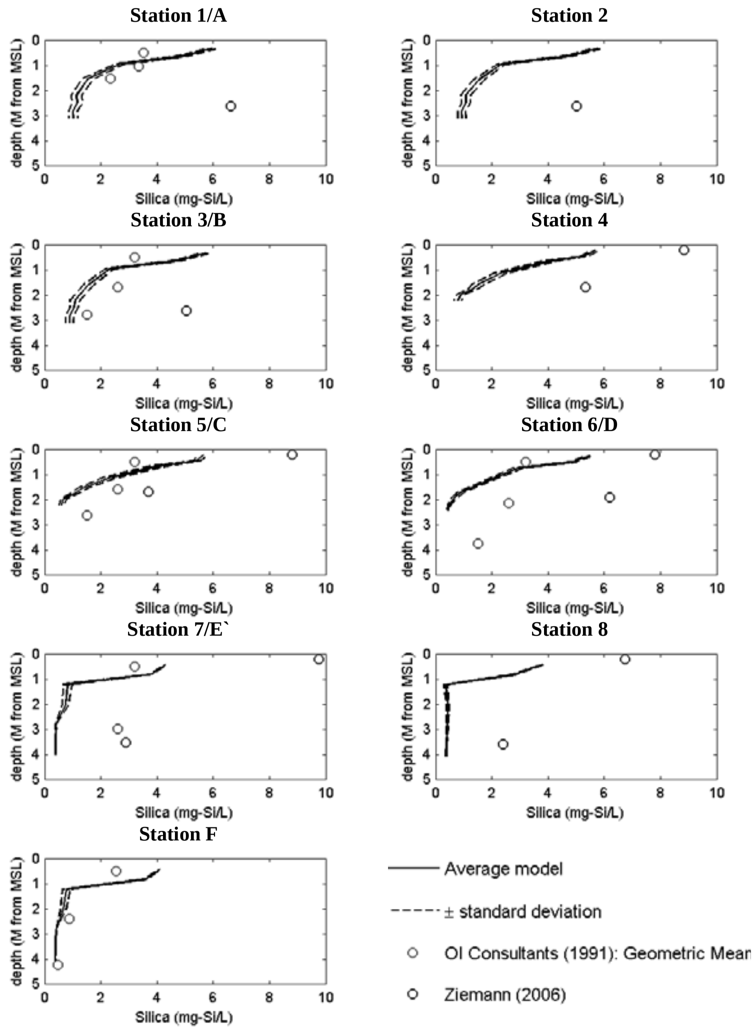


Figure 4-1: Silica (Si) calibration

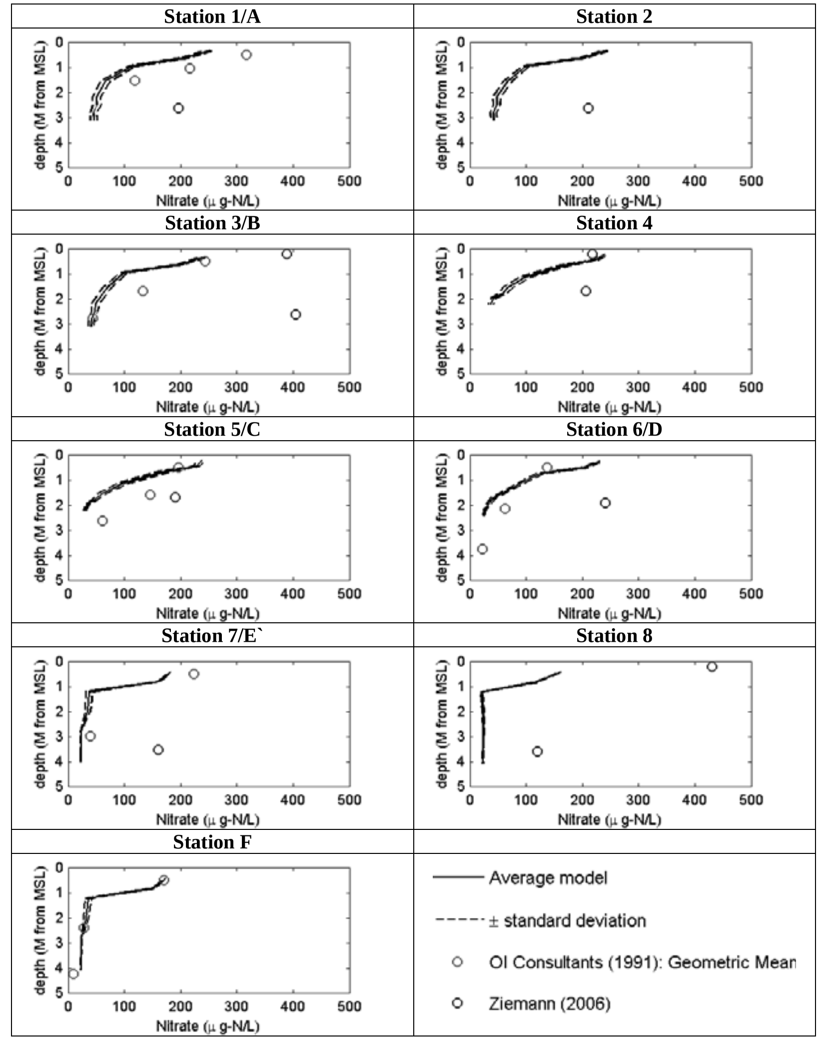


Figure 4-2: NO_3-N calibration

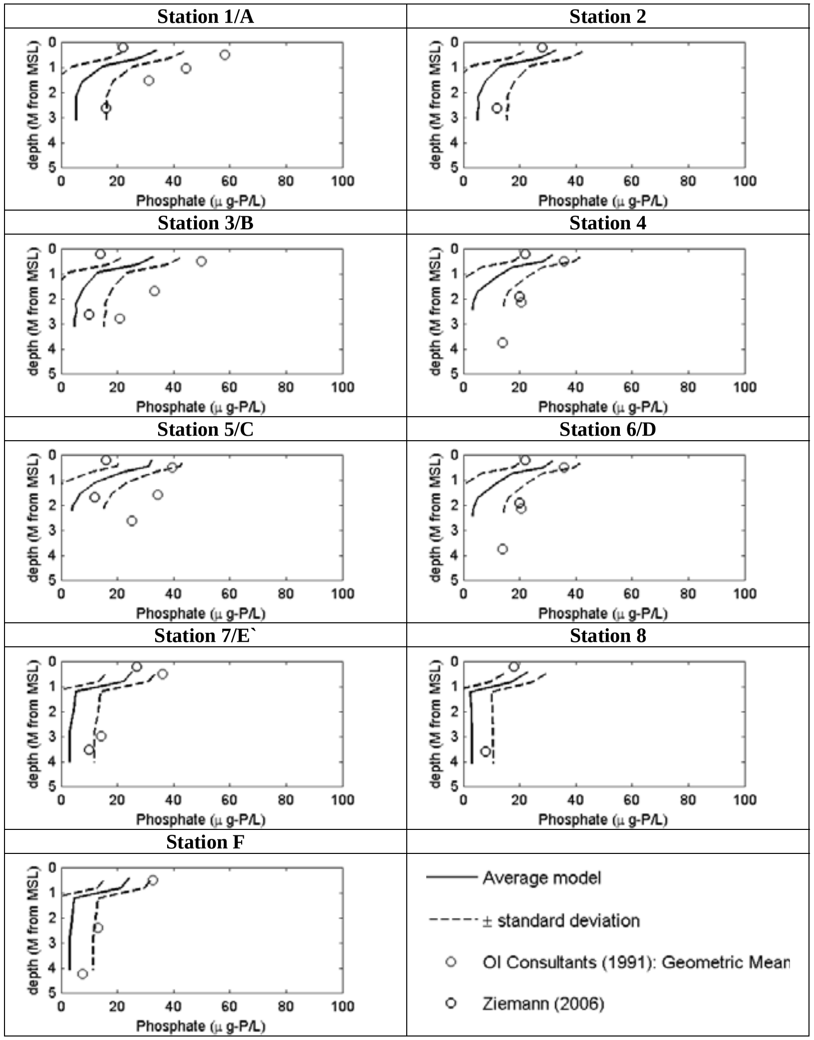


Figure 4-3: o-P calibration

4.7.4 Ammonia-nitrogen (NH_4-N)

The ammonia-nitrogen load into the system is fairly small and seems to agree well with the data. From both 2006 and 1991 (Figure 4-4), the vertical distribution is similar to the other nutrients presented and the model seems to perform well with this distribution. However, in the calibration, ammonium is underestimated at all stations, indicating that loading of the constituent (described in datasets) is insufficient. Corroborating evidence was found in the co-incident overestimation in DO at all Harbor stations. Given the slightly higher values of ammonium-nitrogen in 1991, it is apparent that a shift in loading has occurred, possibly from improvements in a nearby wastewater treatment system. Coincidentally, the DO deficit has also improved significantly from 1991 to 2006, verifying that reductions have occurred in ammonium loading.

The significant increase in concentration measured in the 1991 data set indicates that an additional load may have been introduced between Ziemann (2006) stations 4 and 5. This location corresponds to a restroom that is treated by septic tanks and discharged into the groundwater (Hoover and Gold, 2005). It is presumed that this immediately flows into the existing Harbor, causing a significant ammonia-nitrogen increase as well as a subsequent change in the DO content within the water column. This was tested within the model by adding an additional ammonia load at this point in the model to examine the effects. Figure 4-5 shows the results of the model including this additional load. However, this test load is not considered in the subsequent future conditions section, as it is stated in the EIS submitted on 15 June 2007 that all sewage currently treated by septic tanks will be rerouted to the wastewater treatment plant as part of the project.

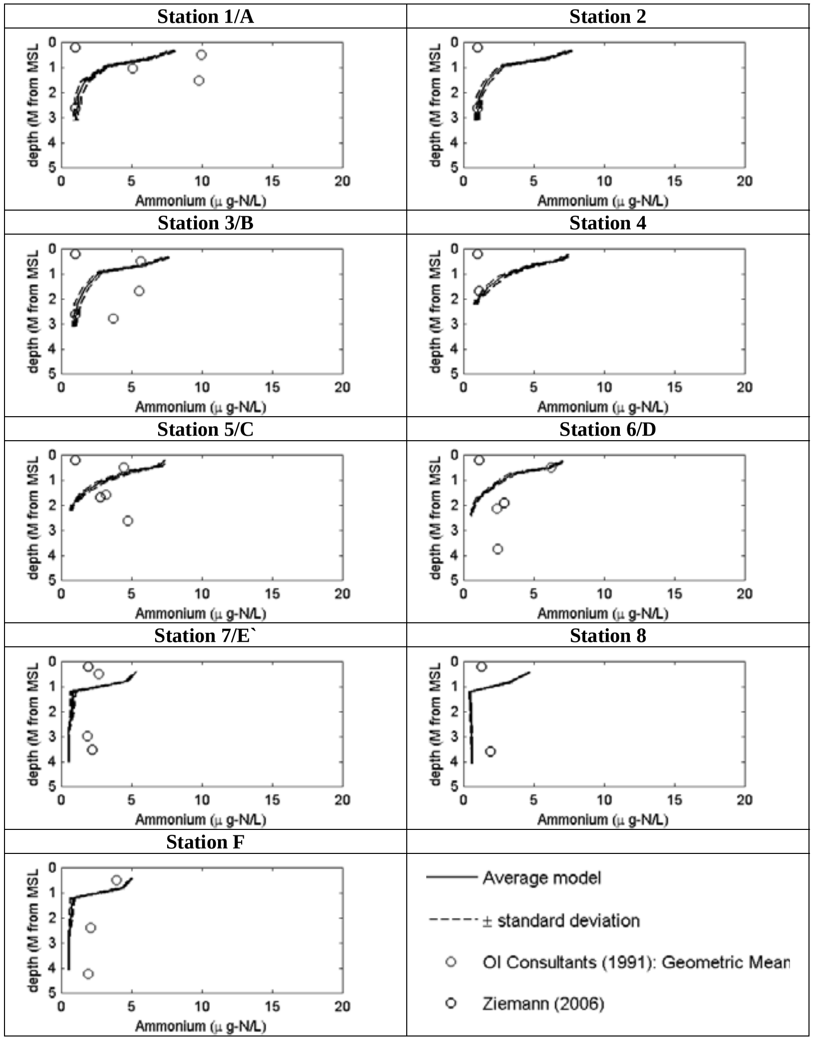


Figure 4-4: NH_4-N calibration

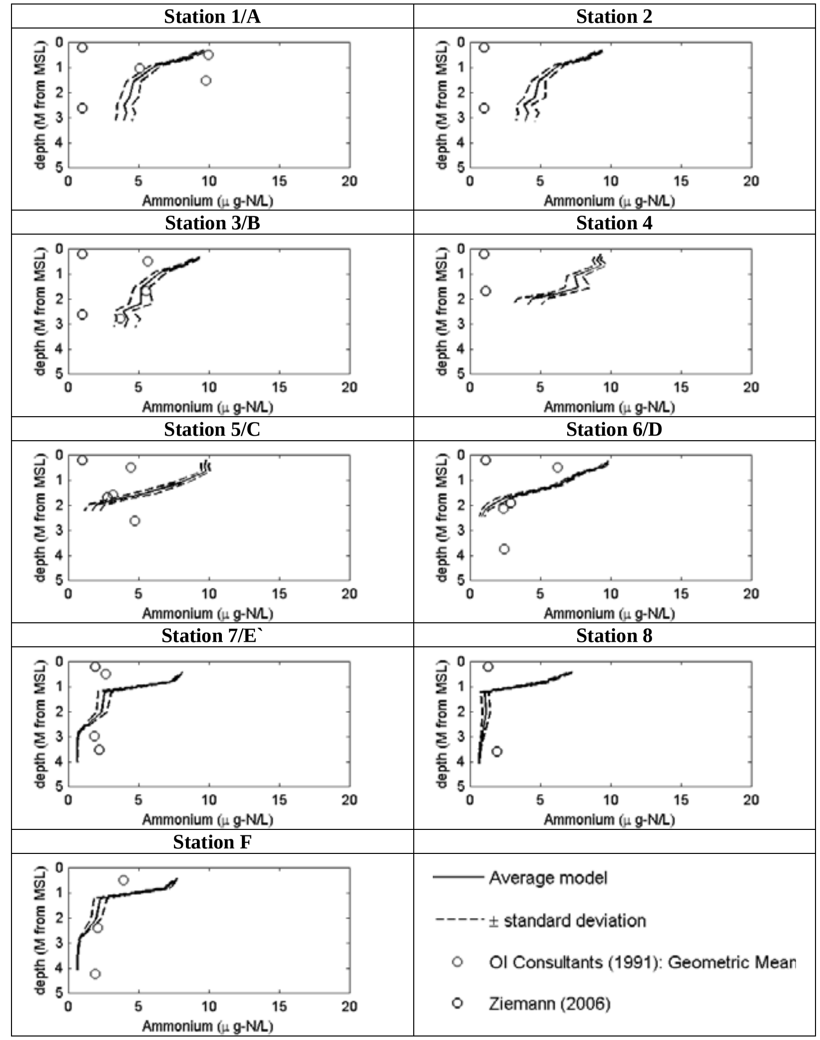


Figure 4-5: NH_4-N with extra load

4.7.5 Dissolved Oxygen (DO)

The DO profiles (Figure 4-6) show that the DO concentrations are lowest at the surface with the low oxygen content coming from the groundwater. As the water gets deeper and there are more phytoplankton growing and producing oxygen and more saline ocean water with DO values around 7.1, the oxygen content gets higher. This seems to corroborate the data from both 1991 and 2006. While the 2006 DO measurements are slightly lower than the data presented in 1991, the DO deficit is actually lower (DO is a function of salinity and temperature), indicating that there has been overall improvement of (i.e., a decrease in) DO-demanding loads in the Harbor since 1991. However, the calibration of DO is overestimated at most of the stations, providing insight that an additional and unknown oxygen-demanding load is not being addressed.

The extra load of ammonia that was discussed in section 4.7.4 is another sink of DO, requiring 4.57 g-O/L per g-N/L. The effect of this was minimal in terms of the vertical distribution of DO within the water column. To avoid repetition, the additional plots are not shown. Since the input of ammonia-nitrogen due to the restroom inflow was 14 µg-N/L, under maximum oxidation, it would only impact the DO by 0.06 mg-O/L, which is not resolvable in the calibration plots. However, it is worth noting, that this effect does exist, and the greater the NH_4-N load on the system, the greater the impact on the DO concentration.

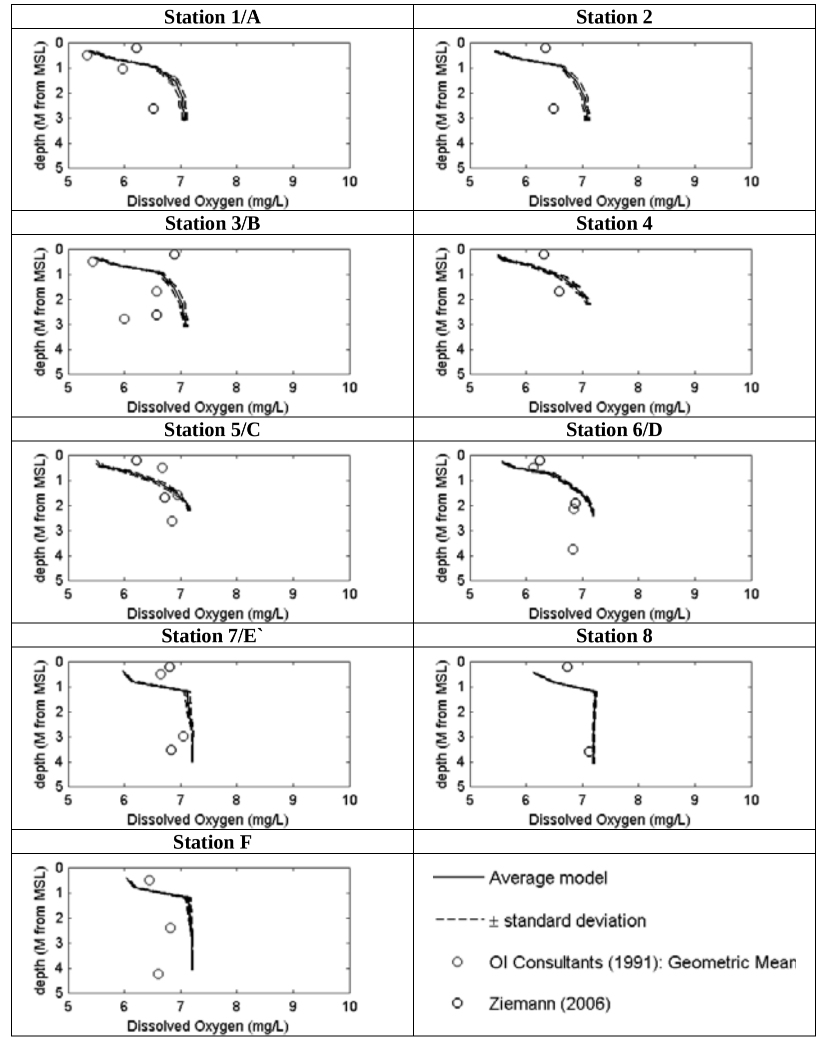


Figure 4-6: DO calibration

4.7.6 Chlorophyll a (CHLa)

Chlorophyll concentrations were extremely variable, especially within the OI Consultants (1991) datasets. Extremely high values were observed at Stations B and C that were too large to fit within the data represented by Figure 4-8. These large values were not replicated in the data collected by Ziemann (2006). The chlorophyll curves that were generated with the model follow the vertical distribution shown by the data and as observed in Bienfang (1982) and OI Consultants (1991). They describe the main vertical position of the algae to be centered in the middle layer of the existing Harbor due to the unfavorable conditions in the top layer (low salinity and temperature), and the light penetration constraint nearer to the bottom of the Harbor (Figure 4-7).

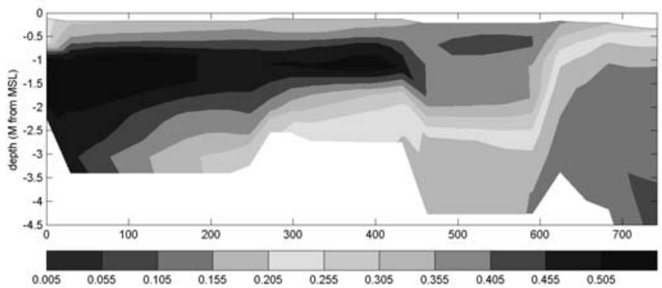


Figure 4-7: Algae concentration (µg –CHL a/L) along Transect EH (Figure 3-12)

It is seen that the chlorophyll has much higher values in the interior of the basin, especially in the middle layer. Nearer to the harbor mouth, the oceanic water dominates the bottom layer and there is less phytoplankton growth. This is also observed in the depth profiles in Figure 4-8, where in the interior basin, the maximum chlorophyll values are in the middle layer of the inner basin. The outer basin has much more stratified layer.

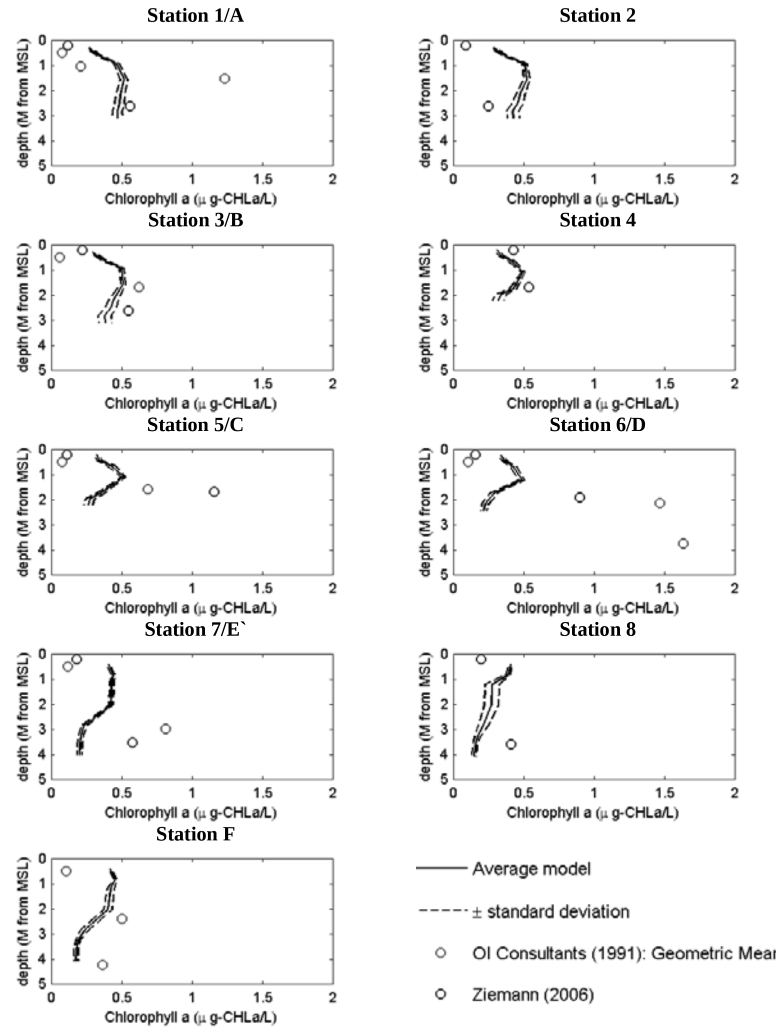


Figure 4-8: Chlorophyll a calibration

Concentrations of benchmark constituents (NO_3-N, o-P, NH_4-N, Chlorophyll a and DO deficit) calibrate well at the back and mouth of the Harbor. This implies that the flushing volume and time, as well as constituent loads, were adequately quantified during calibration. Table 4-5 shows the comparison of the model results with the data variability. It can be seen that in all cases the model difference was less than or equal to the standard deviation of the data, which indicates that the model performance is reasonable.

Table 4-5: Model agreement with data

	Model difference from data (maximum) (1991)	Standard Deviation (data, 1991)	Model difference from data (maximum) (2006)
Silica (mg-Si/L)	2.20	3.19	5.48
Nitrate (mg-N/L)	0.11	0.67	0.46
Ortho-Phosphate (mg-P/L)	0.03	0.03	0.02
Chlorophyll a (mg – CHLa/L)	0.005	0.006	0.0008
Dissolved Oxygen (mg-O/L)	1.09	1.31	1.42
Ammonium (mg-N/L)	0.01	0.01	0.01

4.8 Future Conditions

The following assumptions were made in the determination of future performance of the Honokohau and Kona Kai Ola Marina system. These assumptions were both necessary and appropriate for the typical conditions simulated.

Wastewater Treatment Plant (WWTP) influence on the Groundwater: The high nutrient loads entering the harbor system through the groundwater are not likely to decrease from those observed in the existing Harbor, and therefore it is necessary to find a project alternative that primarily reduces the flushing time within the system to a level that will successfully expel the nutrient laden water from the system. In addition, nutrient levels in the groundwater are considered to be the same as those in the brackish groundwater entering the existing Harbor. Although nutrient levels in Well #6 (Waimea Water Services, 2006) located near the future location of the new Marina are higher than those in the brackish water entering the existing Harbor, the higher levels are likely a direct influence of the WWTP. It is assumed that nutrient levels in the brackish groundwater entering the new Marina will be similar to those entering the existing Harbor, which correspond to groundwater unaffected by the WWTP inflow (see Appendix C). To achieve these conditions the WWTP will be upgraded to tertiary treatment.

Additional point or nonpoint sources into the new Marina: It is assumed that the project will implement point and nonpoint source water pollution control measures. Therefore, simulations included in this study do not include any additional sources. If these control measures were not implemented and additional sources of nutrients are allowed to enter the new marina, results presented in this report could not represent future conditions.

Groundwater consumption: It is assumed that no additional groundwater will have to be withdrawn from the aquifer to be used in the new development and therefore the groundwater levels and volumes will remain the same as existing conditions. Groundwater withdrawal will likely decrease the amount of brackish water reaching the harbor system and coastline. Oki et al. (1999) modeled this reduction using a three-dimensional groundwater model, and found that the decrease in freshwater discharge within the Kaloko-Honokohau National Historical Park could be as much as 0.44 mgd of fresh groundwater. This was obtained by increasing withdrawals upland by about 1.6 mgd. If water is withdrawn from the aquifer it may alter the current amount of brackish groundwater entering Honokohau Harbor. A full groundwater study complete with a three-dimensional, tidally-coupled, variable density groundwater model would be needed to project these effects on existing and proposed conditions.

Groundwater brackish inflow: Since the exact quantity of brackish groundwater inflow to the new Marina is unknown, this value was bracketed between the values of 0 and 60 mgd as in the previous section. Ziemman (2006) indicated that the new Marina will capture brackish groundwater flow that is currently flowing towards some ponds and areas with vegetation downstream of the location of the new Marina. In addition Waimea Water Services (2007) states that a significant quantity of brackish water will be intercepted by the new Marina. Therefore, although the exact amount of brackish groundwater that will be intercepted by the new Marina is unknown, it seems that some amount will be flowing into the new Marina. The effects to the downstream ponds is unknown without a quantity of intercepted groundwater. While some of the solutions shown in the following sections provide adequate water quality conditions post-expansion, it is worth noting that one of the major controlling factors is the brackish groundwater inflow, and without an accurate estimate of this value, a reliable prediction of post-expansion conditions cannot be obtained. In order to estimate the intercepted brackish groundwater flow by the new Marina, a more detailed monitoring effort would be required. This effort will also be used to determine the density differences spatially and in depths below the surface. A tidally coupled variable density groundwater model would also be recommended and would be beneficial to determine the effects of the new Marina construction.

Exhibit Discharge: Discharge from the water exhibits includes nutrient loadings calculated as a function of the marine animal present in the exhibits. The water drawn from the ocean for the marine exhibits was taken from a 100 m depth offshore. This water is drawn approximately along the line of Transect D in Figure 4-9 at 500 m from shore. Due to its depth, at pumping, the temperature of the water is about 3 degrees less than surface water, and this is assumed to increase approximately 1 degree during its retention in the exhibit area. Nutrient loads were determined using a feed ratio of 2% of the population body weight (502 kg/day), and computing the quantity of ammonia-nitrogen (15.06 kg/day) and suspended solids (150.62 kg/day) related to this feed ratio. This resulted in a total ammonia-nitrogen concentration of 53.8 µg-N/L in the exhibit flow entering the new Marina. All computations with regard to the exhibit flow were performed by ClowardH2O (2007) and are documented in Appendix D.

The exhibit also introduces a load of total suspended solids which represents a certain unknown quantity of Carbonaceous Biochemical Oxygen Demand (CBOD) that could further impact the DO. However, results show that the overall impact on the DO in the system is fairly minimal due to the large amount of water inflow with high Dissolved Oxygen concentrations and the high levels of primary production. In addition, compared to the oxygen demand required to satisfy the nitrogenous BOD (NBOD) load coming from the ammonia-nitrogen, the oxygen demand for carbonaceous load is expected to be minimal.

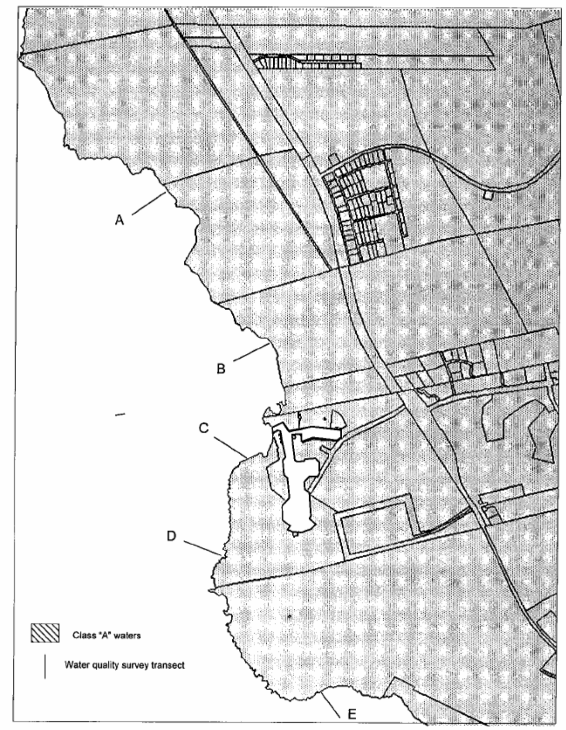


Figure 4-9: Transect location (Ziemann, 2006)

4.8.1 Nutrients

As presented in Section 3.3.4, for all projected scenarios, flushing time is increased, thus, algal residence time is increased within the Harbor. As phytoplankton spend more time within the Harbor without being flushed out, they are able to consume more nutrients. To determine the limiting nutrient under the new conditions, the ratio of nitrogen to phosphorous (N:P) is examined in (Table 4-6). It is shown that the system containing the new Marina is phosphorous-limited. As more o-P is introduced with the brackish groundwater, the N:P ratio decreases but still remains phosphorous-limited. Further discussion of the phosphorous limitation is found in 5.4.2.

Table 4-6: Nitrogen to Phosphorous (N:P) ratio inside existing harbor

Case	N:P ratio within existing harbor	N:P ratio at harbor mouth
Discharge 0 mgd	10.8	8.8
Discharge 15 mgd	8.6	8.2
Discharge 30 mgd	8.3	8.2
Discharge 60 mgd	8.0	8.0

Under low brackish inflow conditions, the addition of phosphorous to the system is immediately utilized. This is compounded by the fact that the need for nutrients is greater due to the longer period of time that phytoplankton remain within the system. It can be seen from Figure 4-10 and Figure 4-11 that the nutrient levels within the existing harbor are depleted much more in all of the future cases than they are under existing conditions. It is also worth noting, that the NO_3-N concentration is reduced more with increasing brackish groundwater discharge (indicating more utilization), because of increased loading of the limiting nutrient, o-P. This is corroborated by examining the o-P concentrations by loading scenario: o-P concentrations are depleted the most with 0 mgd of brackish groundwater inflow, and concentrations increase with higher loadings of brackish groundwater. This not only supports the argument of the phosphorous-limitation on the system, but also indicates that there is sufficient NO_3-N within the system to continue to support more influx of o-P and subsequently more phytoplankton production.

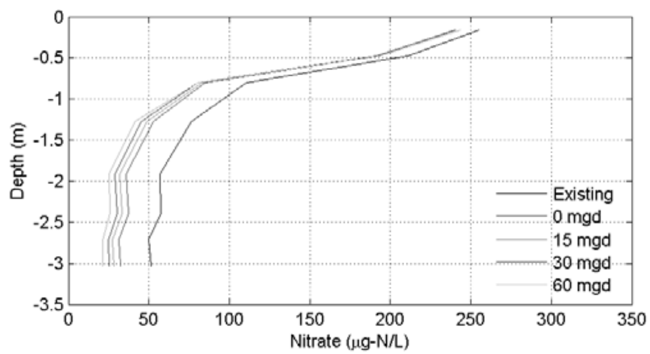


Figure 4-10: NO_3-N concentrations in inner existing Harbor (Figure 3-12)

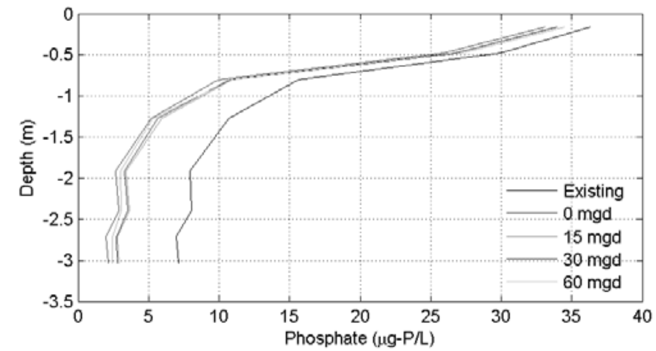


Figure 4-11: o-P concentrations in inner existing Harbor (Figure 3-12)

While this may result in a decrease in NO_3-N and o-P concentrations, it may increase the total nitrogen and total phosphorous loads to the system due to production of N and P substances with the death of phytoplankton.

Due to the phosphorous limitation on the system described, the ammonia introduced from the exhibit flow does not significantly affect the chlorophyll production within the system, as will be shown in a later section. This is not to say that this inflow does not affect the water quality within the system. The load is a significant DO sink, and it causes the system to be even more phosphorous deprived. This deprivation can lead to problems as any new phosphorous source can cause a significant algal bloom.

4.8.2 Dissolved Oxygen

The NBOD load being exerted by the incoming exhibit flow is equivalent to 0.28 mg-O/L. However, due to the high DO content in the exhibit discharges, the model predicts that this load will not adversely affect the DO concentrations. Modeling of the DO within the system shows a daily variability, due to the consumption without production during the nighttime, however the concentration of DO never drops to levels that would be considered problematic. This is due to the high concentration of oxygen in the exhibit flow in combination with the oceanic circulation. It appears that even with the NBOD load, the system remains aerobic. Water quality standards for Hawaii require that the DO remain >75% of the saturation DO for the specific temperature and salinity regime, so that even aerobic systems may violate the State water quality standard. Current data (Ziemann 2006) indicate that the Harbor DO concentrations are approximately equal to DOSat; thus, additional BOD loads should be carefully assessed for impacts to assure compliance with state water quality standards. It is noted that CBOD loads that were not accounted for within the model could do much to impact the DO concentrations in the exhibits and consequently, in the Harbor.

The indicators of phosphorous limitation in section 4.8.1 and the chlorophyll values described in the following section all lead to the conclusion that there will be sufficient algal response from the exhibit-loaded nutrients to affect mesotrophic and possibly eutrophic conditions within the Harbor. Under these conditions, the concentration of DO in the system is likely to decrease significantly, although this is not shown by the model. With a significant increase in algal population, nutrient cycling may effect a substantial re-loading of ammonium back into the water column from bacterial activity at the sediment: water interface[17] resulting in additional NBOD demands on the Harbor DO concentrations. These processes were not included within the existing model due to their relative unimportance within the context of the existing water quality system.

4.8.3 Chlorophyll a

The major focus in the modeling of the system was to project the trophic state of the Harbor following the construction of the new Marina. As discussed in Section 3.3.4, the flushing time of the existing Harbor increased by almost double in most cases due to internal circulation between the new Marina and the existing Harbor. This immediately presents the possibility that the algae growth within the existing Harbor may increase, due to the increased phytoplankton residence time in the Harbor. In addition, the internal circulation is projected to transfer algae and nutrients between the two harbors, without expelling those substances into the ocean. Another problematic factor is that there is also a constant input of phytoplankton and nutrients from the exhibit discharge. All of these factors contribute to increased phytoplankton growth and a potentially eutrophic situation.

Simulation results indicate that increases could be on the order of 10 to 50 times the amount of chlorophyll present under existing conditions (< 1 µg-CHLa/L). Figure 4-12 through Figure 4-15 show the changes in Chlorophyll a concentration within the existing Harbor. It can be seen that significant changes occur throughout the existing Harbor and are not limited to areas adjacent to the new Marina. Despite the decreased flushing time with increased brackish water inflow, conditions are worsened with the largest brackish groundwater discharge simulated, with concentrations 7-8 µg-CHLa/L higher under the new conditions. This is due to the higher nutrient load added by this brackish groundwater inflow. In addition, since the new system is phosphorous-limited, any addition of phosphorous to the system will be immediately consumed by the phytoplankton and will cause rapid growth.

[17] Substantial increases in organic nitrogen loading from death of the larger phytoplankton population result in subsequent settling and accumulation on the bottom. This thicker layer of organic material at the bottom causes effects such as mineralization and denitrification to become important, which can impact the DO significantly within the system.

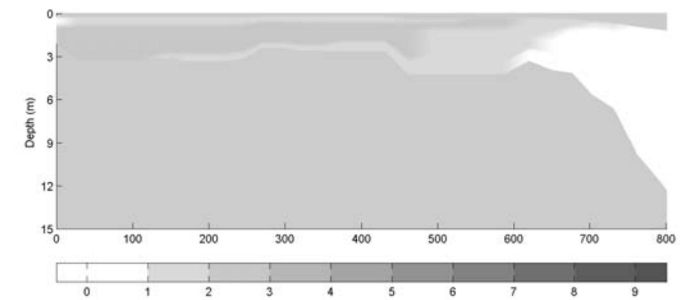


Figure 4-12: Change in Chlorophyll a concentrations (µg-CHLa/L) along Transect EH for 0 mgd brackish discharge

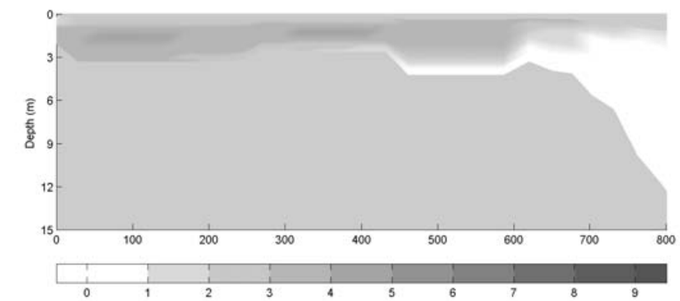


Figure 4-13: Change in Chlorophyll a concentrations (µg-CHLa/L) along Transect EH for 15 mgd brackish discharge

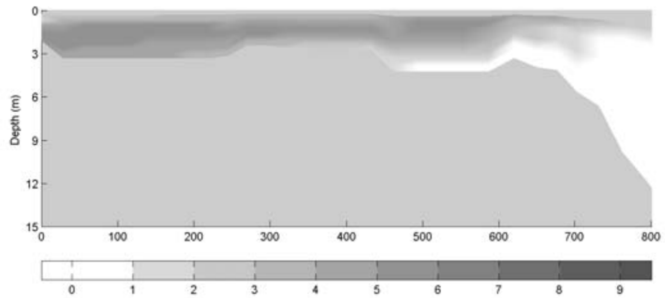


Figure 4-14: Change in Chlorophyll a concentrations (µg-CHLa/L) along Transect EH for 30 mgd brackish discharge

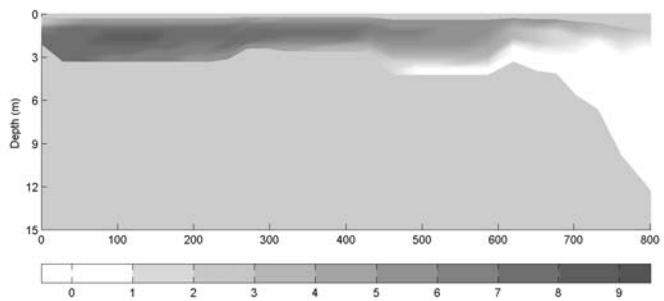


Figure 4-15: Change in Chlorophyll a concentrations (µg-CHLa/L) along Transect EH for 60 mgd brackish discharge

In addition to the increase in flushing time, exhibit and brackish groundwater loads are projected to cause a substantial shift in the system. The water quality within the existing basin becomes degraded as planktonic growth increases. Thomann and Mueller (1987) define a eutrophic system to be one which has chlorophyll values in excess of 10 µg-CHLa/L. For the simulated scenarios, the model-projected conditions will degrade to a mesotrophic level with chlorophyll levels consistently within the range of 4-10 µg-CHLa/L. The resulting increase in chlorophyll levels in the existing harbor may be as high as 8 µg-CHLa/L. The existing system is very oligotrophic with chlorophyll levels remaining below 0.5 µg-CHLa/L. The high levels of Chlorophyll a and the system's sensitivity to phosphorous inputs indicate that with any new point or non-point loads containing phosphorous could advance the system from mesotrophic to eutrophic conditions

It should be noted that conditions reported in both Bienfang (1982) and OI Consultants (1991) reported high values of Chlorophyll a in isolated regions or at specific times; however the model

projections predict that under the typical conditions simulated, almost all locations will have Chlorophyll a values in excess of 4 µg-CHLa/L, the boundary for mesotrophic conditions. Therefore, it stands to reason that during certain times of year, these levels could be much higher.

The only condition that limits the phytoplankton population significantly enough to keep the existing Harbor and new Marina oligotrophic is the condition where the brackish groundwater discharge is 0 mgd. In this case, the o-P concentrations are so small, that the phytoplankton growth is limited by this condition. However, this is not a probable condition due to the high porosity of the rock in the project site, and could only be achieved if the entire new Marina were lined. It is worth noting that even under these conditions any point or non-point sources of o-P would immediately trigger phytoplankton growth, and due to the high flushing time, this would reach undesirable conditions quickly.

The impacts of this change in system dynamics also extend offshore, as the algae and diatoms are carried out of the Harbor. OI Consultants (1991) and Maragos (1983) have shown that coral communities have continued to be established within the Harbor even with the extensions. OI Consultants (1991) reported that the coral population increased from 2.3% to 6.3% between 1981 and 1991 (mostly within the outer harbor).[18] The potential for eutrophication within Honokohau Harbor and the proposed Kona Kai Ola Marina could cause damage to the existing coral populations within Honokohau Harbor and inhibit further growth (Costa *et al*., 2000).

Within the new Marina, there are significant phytoplankton populations that are especially prevalent in the back basin (Figure 4-16 through Figure 4-19). This area of the new Marina has the longest flushing time and is the most saline region of the basin. The water quality in this region may be improved with the introduction of a piped water source coming into the new Marina at a certain flow rate to enhance circulation; however due to the high nutrient levels in the inflow, it is suspected that without a significant reduction in flushing time, the phytoplankton production will remain a problem throughout the new Marina.

[18] In earlier discussions, it is surmised that a population shift may have occurred between the diatoms and phytoplankton. The increased concentration of silica in the Harbor (Ziemann 2006) may indicate that diatom populations have decreased under the phosphorous-limited regime (thus, less uptake of silica). Thus, a small increase in phosphorous may restore the balance of diatoms:phytoplankton, yet the projected water quality degradation from increased nutrients, may mask any benefit to the population dynamics.

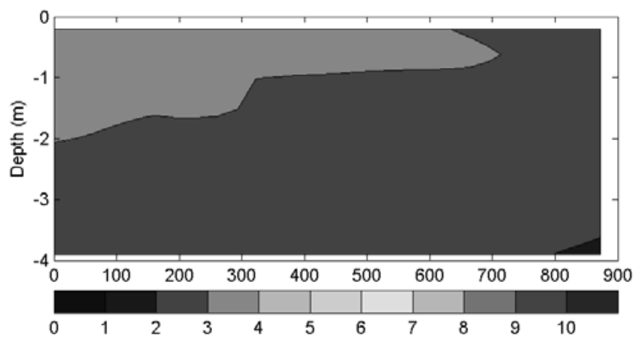


Figure 4-16: Chlorophyll a concentration (µg-CHLa/L) along Transect with brackish inflow of 0 mgd.

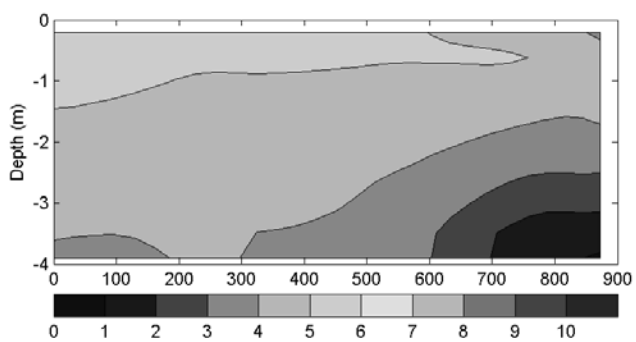


Figure 4-17: Chlorophyll a concentration (µg-CHLa/L) along Transect NM with brackish inflow of 15 mgd.

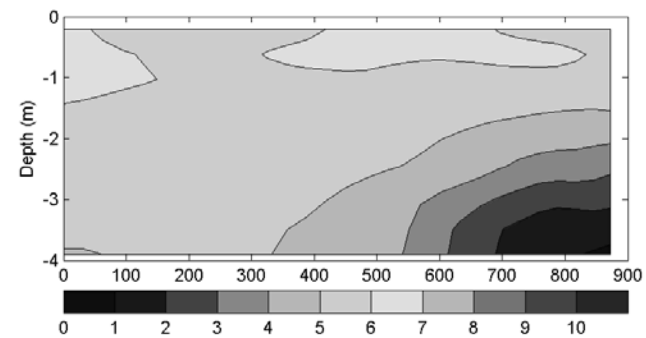


Figure 4-18: Chlorophyll a concentrations (µg-CHLa/L) along Transect NM with brackish inflow of 30 mgd.

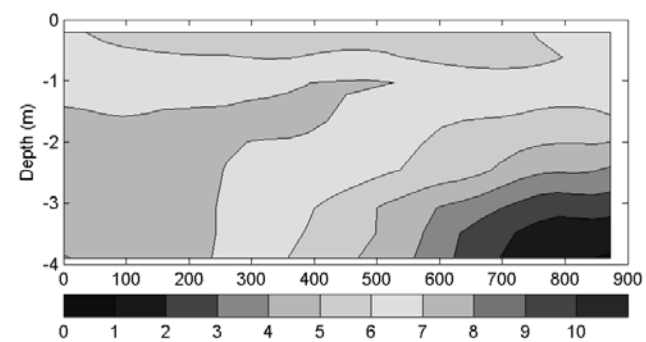


Figure 4-19: Chlorophyll concentrations (µg-CHLa/L) along Transect NM with brackish inflow of 60 mgd.

In addition, the projected chlorophyll leaving the harbor in the upper layers is in much higher concentrations than were found under existing conditions. This will affect the turbidity of the water significantly, as Bienfang (1982) attributed the turbidity within the Harbor to phytoplankton production. Outside of the Harbor, the waters also experience a change in Chlorophyll a concentration in the upper layers. This is important, as it will affect the light entering the water column and may impact biological systems in the nearby area. Figure 4-20 shows the vertical profiles of chlorophyll in the position of station J (OI Consultants, 1991), which is at about the 10 m depth contour outside of the harbor mouth. It can be seen that the surface layers of chlorophyll change significantly with the addition of the new Marina. At lower depths, the change is very slight.

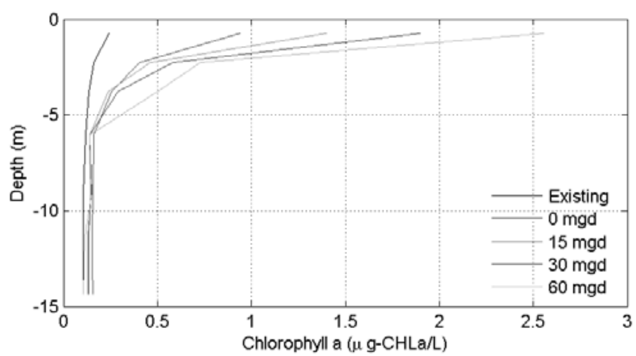


Figure 4-20: Chlorophyll profile outside of Honokohau Harbor (Station J Figure 3-12)

The conditions that were described in the previous section are shown to have unacceptable water quality conditions for all of the bracketed brackish groundwater conditions. Due to the fact that the nutrient loads within the new Marina are phosphorous limited post-expansion, it also indicates that the loads from the exhibit waters are likely not the cause of the additional algae growth within the system. This is further investigated in the following chapter. Since it is not feasible to control or treat the loads coming through the brackish groundwater, it is necessary to find an alternative that will increase the flushing of the new Marina and existing Harbor. The flushing is impaired in the above scenarios due to the internal circulation that exists between the two basins. It is necessary to control this circulation to keep the system flushing and decrease the time spent within the new Marina and existing Harbor by nutrients and algae.

5. ALTERNATIVES TO THE CONCEPTUAL MASTER PLAN

Results presented in the previous section suggested that for the new 45-acre Marina included in the conceptual Master Plan, the existing water quality conditions at Honokohau Harbor could not be maintained in the future two marina system, within the groundwater inflow ranges that were assumed in this study. If the inflow is determined to be greater than 60 mgd, the proposed Marina could be reevaluated. Therefore, it is necessary to examine alternatives to the proposed plan in order to find a solution that is not detrimental to the existing and future harbor system and surrounding waters.

Due to the limiting and unique conditions experienced in Honokohau Harbor and its environs, the mitigation alternatives are required to be unique. As was discussed in Section 3.3.5, a significant impact that occurs with the construction of the new Marina is the introduction of internal circulation between the two Marinas. In order to improve flushing and water quality, it is recommended that this internal circulation is minimized in order to separate the system into 2-layer systems that mimic the pumping that currently exists. The EPA's recommended Best Management Practices for increasing flushing of marinas suggest a number of different options (EPA, 2001: Section 4.1).

- Changing the size or shape of the entrance channel,
- Adding more than one entrance channel,
- Using mechanical aerators in problem areas,
- Optimizing the geometry such that there are as few separated basins as possible, and
- Changing the size of the basin.

The use of mechanical aerators is likely ineffective if not harmful to flushing enhancement in this system. While mechanical aerators may increase the amount of oxygen within the system, they will also vertically mix the system degrading the density stratification that is driving the current flushing. It will also mix nutrients into the bottom layers, which causes concerns for the native coral populations.

The change in size of the new marina is investigated at length in the following sections. Another unique alternative to this system would be to alter the controllable inputs to the system, such as the exhibit outfalls. The placement and inclusion of these outfalls is also investigated in the following sections.

Any further investigation of alternatives needs to be prefaced with an estimation of the inflow of groundwater to the system. Previous and future sections of this report demonstrate the controlling influence of this inflow on both flushing and nutrient loads. Further mitigation investigations will be subject to this estimation.

Adding another entrance channel to the new Marina also was not investigated. The possibility of making the Kona Kai Ola extension an entirely separate entity, leaving Honokohau Harbor entirely intact is another potential solution that could be considered. In this scenario, the internal circulation between the two marinas would be negated, allowing each to function independently.

In this scenario, it is possible that both will flush sufficiently. This option would still depend primarily on the influx of brackish groundwater.

EPA's Best Management Practices (EPA, 2001, Section 4.1) also stress the importance of harbor geometry to flushing. It also claims that the less semi-separated basins a marina contains, the faster the flushing. This was exemplified in the previous chapter's discussion on the internal circulation effects. Due to the geometry of the linkage between Honokohau and Kona Kai Ola Marina which are essentially separated basins with a connection, the circulation between the two marinas was complex and destructive to the water quality. It is likely that if the new Marina was positioned such that it was in line with Honokohau Harbor (like a large box), the flushing of the total system would be improved.

While all of these practices have the potential for improved water quality, the most appropriate practice, or combination thereof, is still dependant on the quantity of brackish groundwater expected to enter the new Marina.

5.1 Assumptions

The assumptions made in order to asses future conditions in Kona Kai Ola Marina (Section 3.3) were maintained for the Alternative analysis.

5.2 Simulated Scenarios

The calibrated hydrodynamics and water quality models described in Chapters 3 and 4 were applied to simulate future conditions for each of the considered alternatives. In this particular application, alternatives were limited to varying the size of the new Marina and the placement of the exhibit discharge; this is due to the computational demands of each test and the need to vary the unknown brackish inflow. In the future, the model could also be used for other alternatives not considered in this study. Table 5-1 and Table 5-2 show the significant computational effort conducted as part of this study. Simulations from Table 5-1, which considered an 800 slip marina as described in the Conceptual Master Plan, were discussed in the previous section with the exception of cases 9 and 10 that consider an alternative location for the exhibit flow outfall.

Table 5-1: Scenarios for 800 slip new Marina

Proposed Harbor Size (800 slips)		
Simulation number	Quantity of Brackish Discharge	Location of Exhibit Discharge
1	0	Back of New Marina
2	15	Back of New Marina
3	30	Back of New Marina
4	60	Back of New Marina
Proposed Harbor Size (800 slips)		
5	0	None
6	15	None
7	30	None
8	60	None
Proposed Harbor Size (800 slips)		
9	0	Back of Existing Harbor
10	60	Back of Existing Harbor

Simulations in Table 5-2 were conducted with a 400 slip marina, variations in the exhibit flow outfall location, and variations in the amount of brackish groundwater that could be intercepted by the new Marina. The 400 slip marina represents a reduction in volume by half of the 800 slip marina. Note, that the purpose of reducing the size in the simulations was to reduce the volume volume of the marina and this was independent of the number of slips that the Marina will finally have. The goal of this large number of simulation is to asses under what future project conditions water quality conditions within the Harbors and along the coastline of the state Park could be optimized.

The model that was constructed and described in Section 3.3 was modified to represent a new Marina layout that would effectively reduce the original volume by approximately one half. The resulting model grid is shown in Figure 5-1. For simplicity, the bathymetry within the Marina was kept the same as previously described. The goal of the reduction was to lower the flushing time within the new and existing Marinas and remain as close as possible to the conditions that presently exist within Honokohau Harbor.

Hydrodynamic, flushing time, and water quality numerical models were implemented using the conditions described in Section 3.3. The tidal conditions for the water quality model were further constrained to only represent one representative tidal cycle repeated in order to increase computational efficiency for the large quantity of simulations that were considered. This repeated signal is shown in Figure 5-2. Note that the model is representative of typical conditions and therefore neglecting the spring/neap variability of the tidal signal should not influence the conclusions extracted from the comparison of alternatives. Furthermore, sensitivity tests were carried out to compare results between simulation with a repeated representative tidal cycle and with a complete spring/neap tidal signal. These tests indicated that simulated water quality conditions are mainly controlled by the different water inflows into the system (groundwater brackish water and exhibit flow) and that tidal variability only incorporates some variability into the parameters. Water quality simulations with the repeated representative tidal cycle were carried out until the conditions in the harbor have achieved a relative steady situation.

Table 5-2: Scenarios for 400 slip Marina

Proposed Harbor Size (400 slips)		
Simulation number	Quantity of Brackish Discharge	Location of Exhibit Discharge
11	0	Back of New Marina
12	10	Back of New Marina
13	20	Back of New Marina
14	30	Back of New Marina
15	60	Back of New Marina
Proposed Harbor Size (400 slips)		
16	0	None
17	10	None
18	20	None
19	30	None
20	60	None
Proposed Harbor Size (400 slips)		
21	0	Back of Existing Marina
22	10	Back of Existing Marina
23	20	Back of Existing Marina
24	30	Back of Existing Marina
25	60	Back of Existing Marina

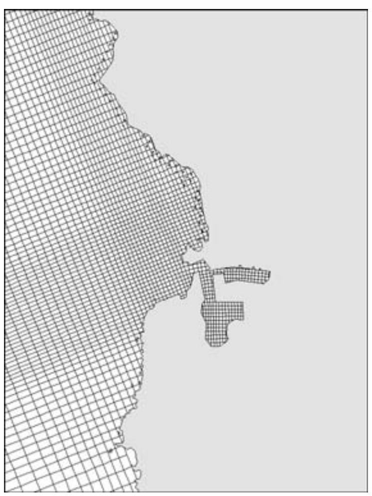


Figure 5-1: Adjusted grid for 400 slip Marina

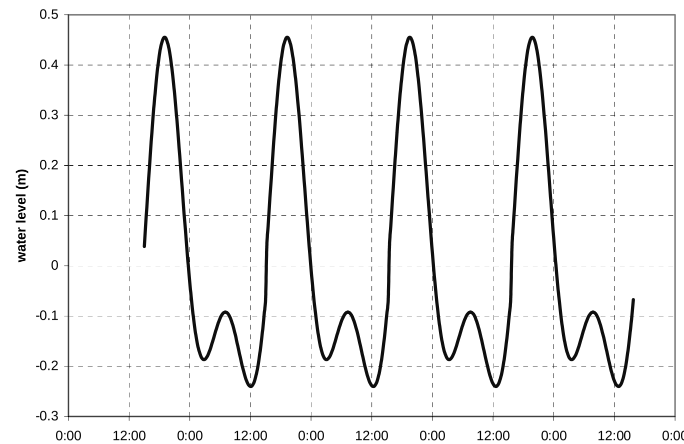


Figure 5-2: Repeated tidal cycle used for water quality simulations

5.3 Flushing Time

The major indicator of the water quality of a harbor is its flushing time. Ferreira et al. (2005) reported that flushing time is the most significant controller of eutrophication and biodiversity within a system. Flushing time results of the simulations using the 800 slips Marina of the Conceptual Master Plan described in Section 3.3 are also presented in Figure 5-3. Cases where the exhibit outfall discharges at the back of the new Marina were considered. In order to assess the effects of the discharge on the marinas, it was also excluded from the model in order to test the model's reaction to its inclusion. This condition could be representative of discharging the outfall offshore or eliminating the exhibits altogether. For the 800 slip marina, all cases showed a significant increase in flushing time from the current conditions. Flushing time increased in the existing Harbor from 12 hours to values up to 35 hours when no brackish groundwater inflow is considered in the new marina. At the new Marina flushing time could reach values up to 60 hours when neither brackish groundwater inflow nor exhibit flow is considered. Adding the exhibit flow into the existing marina proved to be effective in reducing the flushing time in the existing harbor from the aforementioned values particularly for the case of 60 mgd brackish groundwater inflow into the new Marina. The new Marina is not affected significantly by the change in pipe location. However, the values indicate that the situation still may not meet the water quality conditions that currently exist within Honokohau Harbor and indicate that water quality still may be impacted post-expansion.

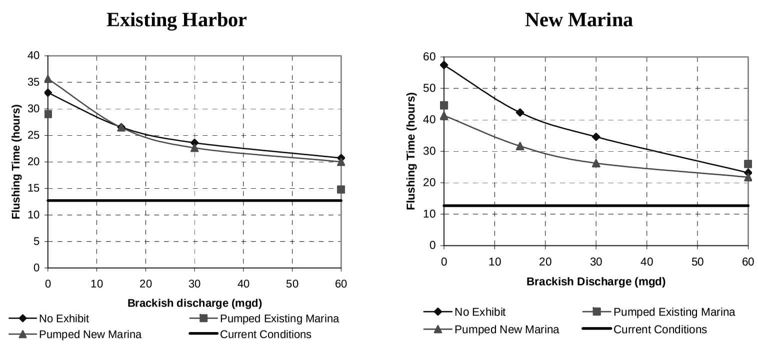


Figure 5-3: Flushing times of 800 slip marina

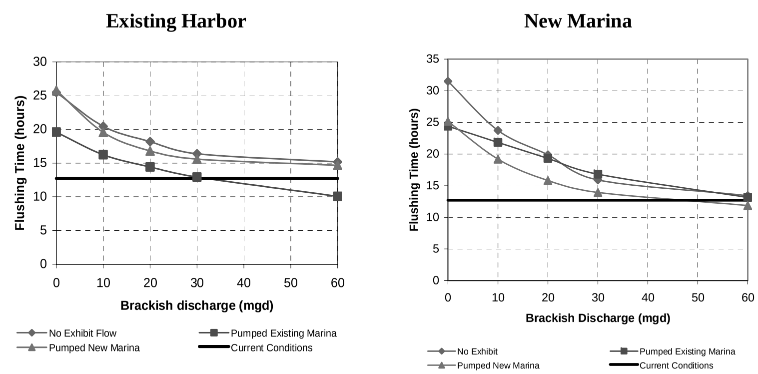


Figure 5-4: Flushing times of 400 slip Marina

In order to decrease the flushing time of the two-marina system, a reduction in the size of the proposed Marina was considered. Comparison of Figure 5-4 with Figure 5-3 shows that the reduction of the Marina size to 400 slips significantly affects the flushing times in both the existing and new Marinas for all the cases simulated. The influence is about five hours, which is significant when considering that the phytoplankton growth in a system with unlimited nutrients is exponential in time. In addition, pumping the exhibit discharge into Honokohau Harbor clearly reduces the flushing time in the Harbor significantly (> 5 hours: 25% improvement at Q=0 mgd and 50% improvement for Q=60 mgd), and pumping it into the new Marina also has an effect, but one that is less pronounced due to the size of the new Marina (2-3 hours). The flushing times under high brackish groundwater inflow conditions are comparable to the flushing

times under existing conditions, which may be sufficient to control algae growth within the new Marina. It should be noted that while the interception of brackish flow into the new Marina may help the water quality within the Harbor, it is also the source of inflow to the anchialine ponds west of the proposed new Marina and the quantity of water intercepted could impact the salinity of these ponds significantly, changing the ecology of these systems (Ziemann, 2006). Note also that the increase in brackish groundwater inflow to the Harbor system will increase the quantity of brackish water leaving the system at the harbor mouth, which could have impacts on the salinity of the surrounding areas. In particular, examining the salinity profiles obtained from the model simulations at station J (OI Consultants, 1991) shows that largest differences in salinity are observed at the surface; the differences are less than 1 ppt for the 60 mgd groundwater brackish inflow into the new Marina (Figure 5-5 through Figure 5-9). As brackish inflow increases into the Honokohau/Kona Kai Ola system, the layer at the surface outside of the Harbor becomes less dense. In addition, the position of the exhibit discharge influences the salinity at the surface outside of the harbor. When the exhibit discharge is positioned at the back of Honokohau Harbor the salinity in the surface layers is higher. The lowest salinity occurs when an exhibit discharge is not included at any location.

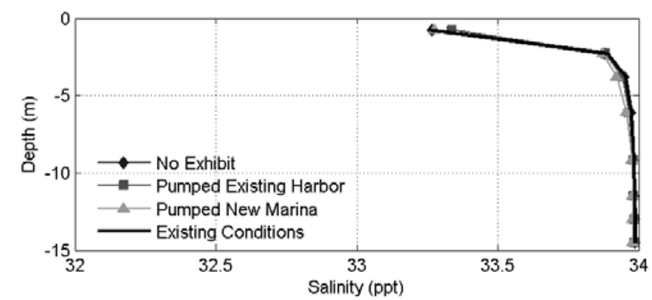


Figure 5-5: Salinity profile at station J (OI Consultants, 1991) for 0 mgd brackish inflow

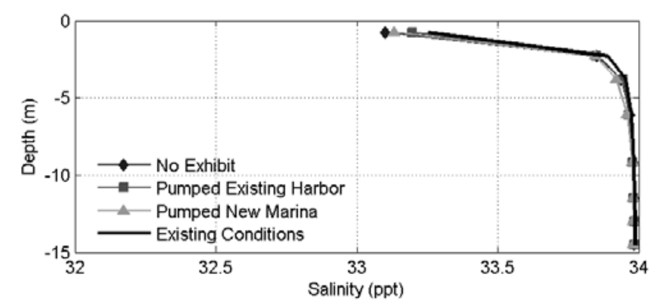


Figure 5-6: Salinity profile at station J (OI Consultants, 1991) for 10 mgd brackish inflow

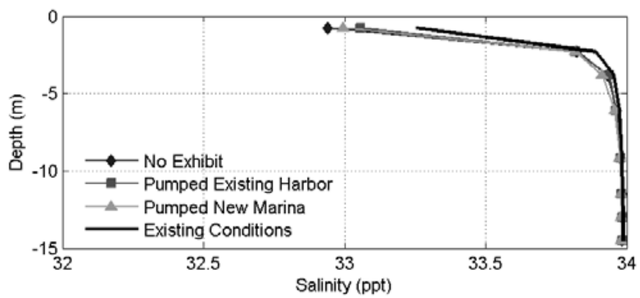


Figure 5-7: Salinity profile at station J (OI Consultants, 1991) for 20 mgd brackish inflow

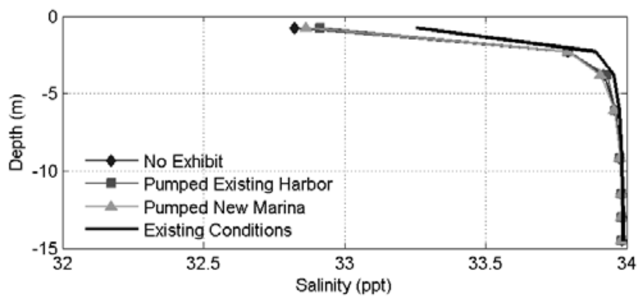


Figure 5-8: Salinity profile at station J (OI Consultants, 1991) for 30 mgd brackish inflow

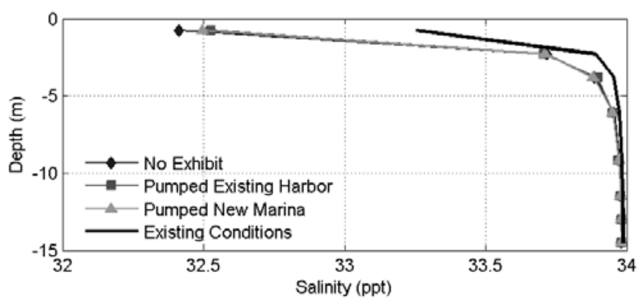


Figure 5-9: Salinity profile at station J (OI Consultants, 1991) for 60 mgd brackish inflow

5.4 Nutrients

Nutrient loads into the proposed new Marina are extremely dependent on the brackish water inflow. Since this quantity is unknown but has been bracketed into "reasonable" values for these simulations, it is difficult to determine exactly what the final nutrient profile will be within the proposed system. Because present conditions within Honokohau Harbor will be affected by the construction of the new Marina, it is beneficial to examine these effects in a broad manner. The two conditions that are available for comparison are the present conditions within Honokohau Harbor and the guidelines set by the state of Hawaii for water quality in the region. The following sections will describe the standards and classifications set, the future conditions that are typically expected within the Marina systems and the typical conditions that are expected immediately outside the Harbor mouth. Nutrient concentrations along the coastline of the Kaloko-Honokohau National Historical Park will be examined in a later section for selected scenarios.

5.4.1 Hawaii State Standards

Water quality standards for the state of Hawaii are described in Chapter 54 of the Hawaii revised statues (Department of Health, 2004). Water quality standards for the state of Hawaii designate Honokohau Harbor as Class A recreational area. The waters surrounding Honokohau Harbor are designated as Class AA pristine waters with stricter standards. It is therefore necessary to determine whether the existing Harbor is currently meeting the water quality standards and to determine whether the new Marina will create worse conditions with respect to standards in the area. Table 5-3 presents the Hawaii water quality standards; the values reported are geometric means for wet conditions. This assumes that additional, non-tidal inflow to the Harbor consists of greater than 1% of the total volume of the Harbor, which is the specification for Class A waters. The State also mandates exceedance criteria for the areas; however due to the assumption of typical conditions for the model, these criteria cannot be analyzed.

Table 5-3: Hawaii water quality standards

	Class A	Class AA
Ammonia-nitrogen (NH_4-N)	6 µg-N/L	3.5 µg-N/L
Nitrate-nitrogen (NO_3-N)	8 µg-N/L	5 µg-N/L
Total Phosphorous (PO_4-P)	25 µg-P/L	20 µg-P/L
Chlorophyll a (CHLa)	1.5 µg-Chla/L	0.3 µg-Chla/L

5.4.2 Nutrients within Honokohau Harbor and Kona Kai Ola Marina

For the purposes of this brief analysis of alternative performance, it was necessary to develop a mean value that represents the Harbors rather than describing the spatial and temporal variability. The spatial attributes of a select number of cases are described at length in a later section. For these purposes, all values were tidally averaged over the representative period after the model reaches a quasi-steady state solution and were then averaged over depth and space for both the Honokohau Harbor and Kona Kai Ola Marina. These areas are delineated in Figure 5-10. In this figure, the overlapping region between Kona Kai Ola Marina and Honokohau Harbor near the Harbor entrance is spatially averaged into both regions.

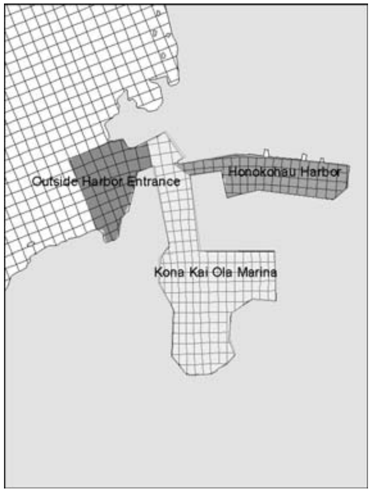
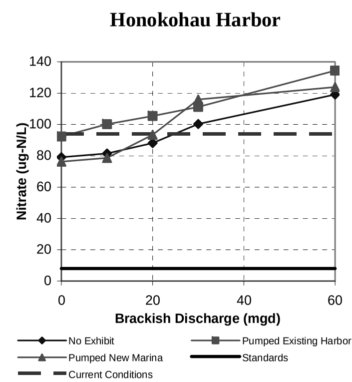


Figure 5-10: Locations of spatial averaging

These values do not represent variability related to seasonal tidal cycles or any seasonal effects. They are merely used as a gauge for measuring the changes in water quality associated to the different simulated scenarios.

Nitrate-nitrogen (NO_3-N)

The average nitrate-nitrogen values within Honokohau Harbor and the 400 slip Kona Kai Ola Marina are shown in Figure 5-11. It can be seen that even under existing conditions, the NO_3-N concentrations are not within the Hawaii standards for Class A waters. The 400 slip harbor shows NO_3-N concentrations increasing in a nearly linear trend as the quantity of brackish groundwater increases. Levels in the existing Harbor are highest for the cases where the exhibit water is pumped into the existing Harbor since this water is high in NH_4-N which is then nitrified into nitrate. In addition, the shorter flushing time that occurs in the Harbor with the added exhibit flows does not allow for as much algae growth and nutrient utilization, leaving the water column concentrations higher than in the other scenarios. The nitrate levels within the new Marina tend to be lower than the levels in the existing Harbor. This is due to the fact that the volume of the new Marina is larger than that of the existing Harbor which dilutes the nutrient concentrations in brackish groundwater inflows.



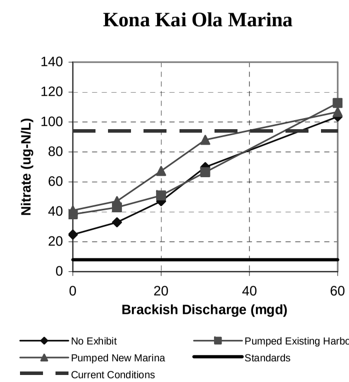


Figure 5-11: Nitrate-nitrogen (NO_3-N) conditions within Honokohau Harbor and 400 slip Kona Kai Ola Marina

Ortho-Phosphate(o-P)

Ortho-phosphate concentrations for Honokohau Harbor and the 400 slip Kona Kai Ola Marina are shown in Figure 5-12. These concentrations show a near linear trend similar to the concentrations of NO_3-N within the two harbors. Existing conditions show concentrations within the Hawaii standards for Class A waters. The proposed Marina does not increase the levels significantly for existing conditions and even in low brackish groundwater conditions, it results in a lowering of the ortho-phosphate concentrations.

Ammonia-nitrogen (NH_4-N)

NH_4-N values within the existing and new Marinas are shown in Figure 5-13. It is obvious that pumping the exhibit discharge with high NH_4-N concentrations into the existing Harbor significantly affects the ammonium concentrations in the existing harbor, exceeding the Hawaii state standards by almost 10 µg-N/L. This effect is also present in the new Marina when the exhibit flow is pumped into the back wall. The ammonia concentrations increase by about 6 µg-N/L also driving them above Hawaii state standards, although the effect is not as pronounced as that which occurs within Honokohau Harbor mainly because the larger volume of Kona Kai Ola Marina dilutes the concentrations to lower values within the new Marina.

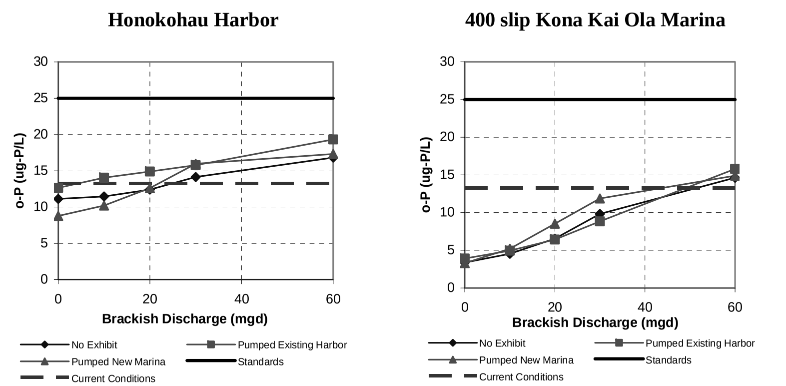


Figure 5-12: Ortho-phosphate (o-P) concentrations within Honokohau Harbor and 400 slip Kona Kai Ola Marina

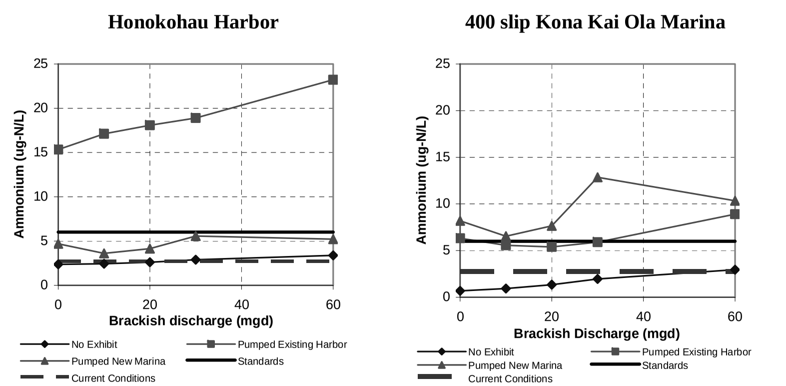


Figure 5-13: Ammonium-nitrogen (NH_4-N) concentration within Honokohau Harbor and 400 slip Kona Kai Ola Marina

<u>*Chlorophyll a (CHLa)*</u>

The Chlorophyll a values within the existing and new Marinas were computed based on the kinetic and physical dynamics of the system. It was found that decreasing the size of the new Marina was beneficial in controlling the excessive algae growth that was found to be problematic under the proposed 800 slip Marina. Under the groundwater inflow ranges modeled, it is found

that the smaller new Marina remains below approximately 3 µg-chla/L for all solutions (Figure 5-14). This indicates that both Marinas will exist in an oligotrophic state under typical conditions. In order to reach the Hawaii Class A standards that are set for Honokohau Harbor, a number of different scenarios were tested. It was found that with high levels of brackish water inflow, the harbors are more likely to be close to or below the Class A standards. The algae growth within the existing Harbor is severely limited when the exhibit flow is pumped into the back of this harbor. This indicates that this would be the best scenario to maintain the water quality within Honokohau Harbor. Pumping the exhibit flow into the back of the new Marina also benefits the existing Harbor, but the effect is not enough to lower Chlorophyll a concentrations to existing levels. With the cases corresponding to the mid-inflow values (20-30 mgd, which is similar to the inflow into the existing Harbor), brackish groundwater inflows into the new Marina show a significant decrease of Chlorophyll a concentrations at the Marina where the exhibit water is discharged.

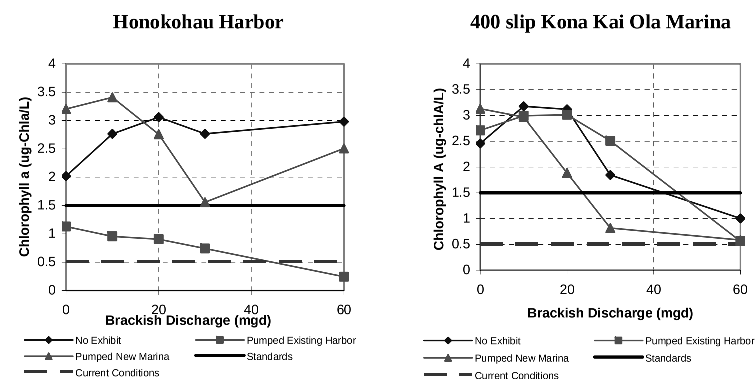


Figure 5-14: Chlorophyll a concentrations within Honokohau Harbor and 400 slip Kona Kai Ola Marina

It can be seen from the above analysis that simulations when the brackish groundwater flow into the new Marina are in the order or greater than 30 mgd, provide conditions that are approaching or within water quality standards for Class A waters. In addition flushing under these conditions appear to control the eutrophying potential of the high nutrient loads coming in from the brackish groundwater. These brackish groundwater inflow conditions seems to be possible based on the expert opinion of Waimea Water Services (2007) who states that it is likely that the construction of Kona Kai Ola Marina will likely intercept significant brackish groundwater post-expansion. In addition, it is expected that if the inflow of brackish groundwater is even higher than was tested, the flushing will be even more pronounced and the water quality conditions could be even better.

Another important observation is the influence of the exhibit water entering the marina. The exhibit water does not seem to affect the growth of algae except in its relationship to the flushing of the Harbor and Marina. Due to the nutrient limitations discussed in the following section, the additional nitrogen load does not cause additional algae growth, however it does cause increased ammonia and nitrate loads. It is expected that if this load is reduced, the exhibit inflow will have a beneficial additional flushing effect and at the same time it will not affect algae growth.

Nutrient Limitation

The limiting nutrient within the new and current system was found to be ortho-phosphate. This was tested in two ways. Among all the simulated cases, there are scenarios that contain "extra" nitrogen from the exhibit flow without additional phosphorous concentration. If the system were to be nitrogen limiting, this addition of available nitrogen to the system would cause additional algae growth. However, as is seen in the above section, the Chlorophyll a production with the addition of the exhibit flow is minimal at best. In addition, in other sensitivity tests, the phosphorous concentration in the brackish inflow was increased arbitrarily by a factor of two to determine if this would cause additional algae growth. In fact, the chlorophyll production increased significantly with the addition of extra ortho-phosphate, which corroborates the phosphorous limitation discussed in Section 4.8.1.

This determination is important as it signifies the impact of additional phosphorous loads on the system and the need to monitor those loads extremely carefully to maintain the water quality within the system.

5.4.3 *Nutrients immediately outside Harbor Entrance*

The area immediately surrounding the harbor mouth is examined in OI Consultants (1991). This area was examined for all the simulated cases in order to determine the effect that the new Harbor system has on the water quality conditions at the immediate surrounding waters. This area is also shown in Figure 5-10. Similarly to the analysis performed for Honokohau Harbor and Kona Kai Ola Marina, the model results at the selected location outside of the Harbor entrance were tidally averaged over the representative period after the model spin-up period and were then averaged over depth.

Nitrate-nitrogen (NO_3-N)

The average nitrate-nitrogen values outside of the Harbor entrance are shown in Figure 5-15. It can be seen that even under existing conditions, the nitrate-nitrogen levels exceed the Hawaii standards for Class AA waters. Nitrate levels increase in a nearly linear trend with the groundwater brackish inflow into the new Marina. Nitrate concentrations are higher when the exhibit water is pumped into the Marina system since this water is high in ammonia which is then nitrified into nitrate. In general, nitrate concentrations after the new Marina construction are expected to be in the same order to those observed under existing conditions.

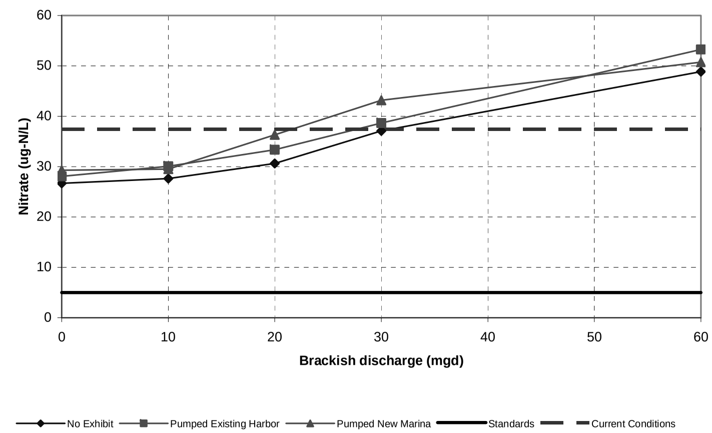


Figure 5-15: Nitrate-nitrogen concentrations outside Harbor entrance

Ortho-Phosphate (o-P)

Ortho-phosphate levels outside of the harbor entrance are shown in Figure 5-16. These concentrations show a near linear trend similar to the values of nitrate outside of the Harbor entrance. Existing conditions show concentrations within the Hawaii standards for Class AA waters. The proposed Marina does not increase the levels significantly from existing conditions and even in low groundwater brackish inflow, it results in a lowering of the ortho-phosphate levels.

Ammonium-nitrogen (NH_4-N)

NH_4-N levels outside of the Harbor are shown in Figure 5-17. This shows that NH_4-N concentrations are noticeably increased by including the exhibit flow, however still meet the Hawaii state standards. The influence of the exhibit flow is most pronounced outside of the harbor when it is pumped into the existing Harbor.

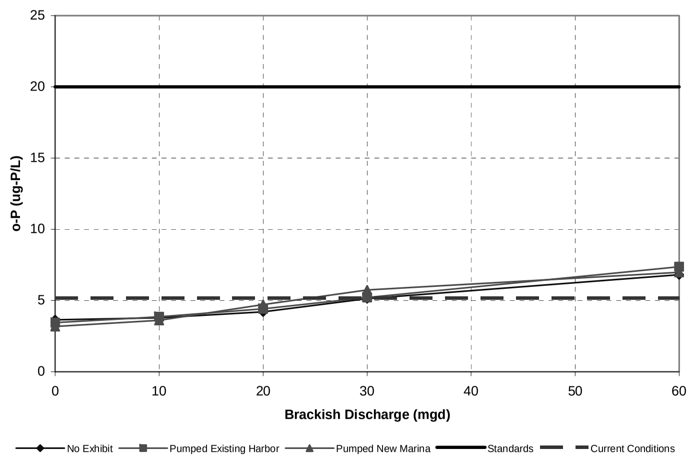


Figure 5-16: Ortho-phosphate conditions outside Harbor entrance

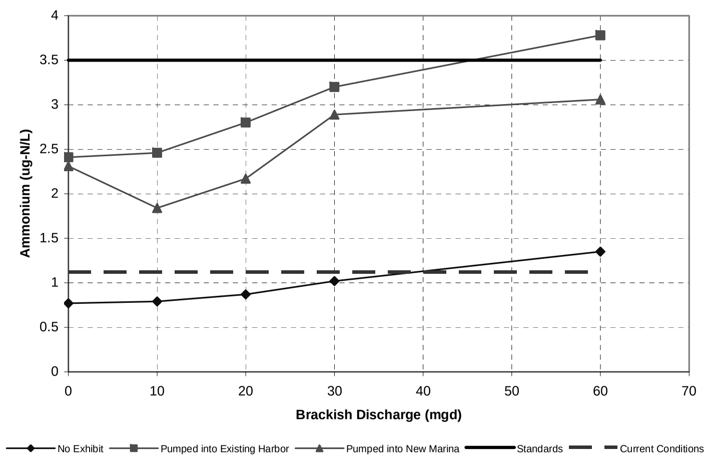


Figure 5-17: Ammonium conditions outside of the Harbor entrance

Chlorophyll a

Immediately outside the Harbor entrance, the Chlorophyll a values are mainly confined to the surface layers of the system for all scenarios. Figure 5-18 shows the tidally and depth averaged values for the area just outside of the Harbor. These values appear to consistently exceed Class AA standards shown in Table 5-3; however they all fall below the standards for Class A waters (Table 5-3). Due to the area's proximity to the Harbor entrance, this may still remain acceptable as long as the algae dies and is diluted within a reasonable distance from the Harbor mouth. This is examined in more detail in Section 6.

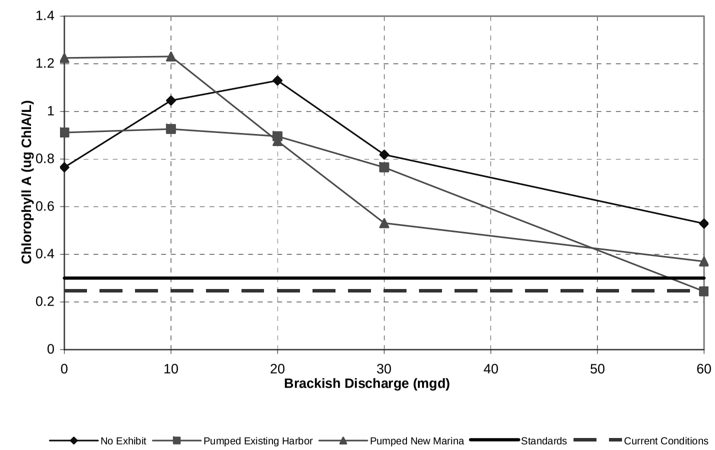


Figure 5-18: Chlorophyll a values outside the Harbor entrance

5.5 Detailed Description of Two Alternatives

From all the simulated alternatives, two were selected for further discussion. In order to select these two cases, the following conclusions from the model results were considered:

- While the cases pumping the exhibit flow into the existing Marina provided overall better water quality results, it may be considered not advantageous to further impact the conditions of Honokohau Harbor.
- Since the addition of the large quantity of water from the exhibits does have slightly beneficial results in terms of flushing time and the excess nitrogen does not affect the water quality due to the phosphorous limitation, cases including the exhibit flow in the new Marina were selected.
- Since the brackish water inflow is an unknown quantity, one reasonable assumption is that the same amount of water that is intercepted by the existing Harbor could also be intercepted by the new Marina. Therefore, the 30 mgd case was selected as the most reasonable case with beneficial results.

- In addition, the case containing 0 mgd of brackish groundwater is also analyzed as a bounding case, since this condition appears to cause some of the worst algae production. It is worth noting that although the case with 0 mgd of brackish inflow does allow significant algae growth, all the cases analyzed with a 400 slip marina create oligotrophic conditions in both new and existing Marinas, while some cases analyzed with the 800 slip marina led to eutrophic conditions.

5.5.1 *Case 1: 400 slip New Marina, 0 mgd brackish groundwater inflow, exhibit flow pumped into new Marina*

Currents

The velocity structure under this alternative that is without brackish groundwater into the new Marina is similar to the conditions observed with the 800 slip Harbor. Density currents are not generated within the new Marina due to the lack of brackish groundwater inflow. Therefore, internal circulation between the two harbors remains problematic as in the 800 slip case. The new Marina still shows a top layer moving towards the back of the new Marina from the existing Harbor (Figure 5-19) and a bottom layer moving out towards the ocean. The back end of the new Marina is defined at 0 m. This internal circulation prevents the two-layer "pumping" observed under existing conditions in Honokohau Harbor. It therefore increases the flushing time, which is 25 hours in this scenario, and leads to build up and growth of algae within the system.

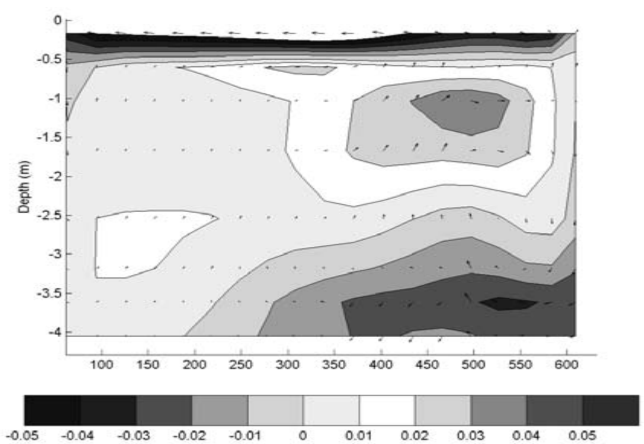


Figure 5-19: Velocities at peak flood (m/s) along Transect NM (Figure 3-12) for Case 1

At the Harbor mouth the depth distribution of velocities is similar to those shown in Sections 3.2.6 and 3.3.5. The profiles shown in Figure 5-20 are at the location specified in Figure 3-12. It is seen that during ebb tide for this scenario, there is no water entering from the ocean at the bottom layer, which could also impact the amount of flushing that is occurring.

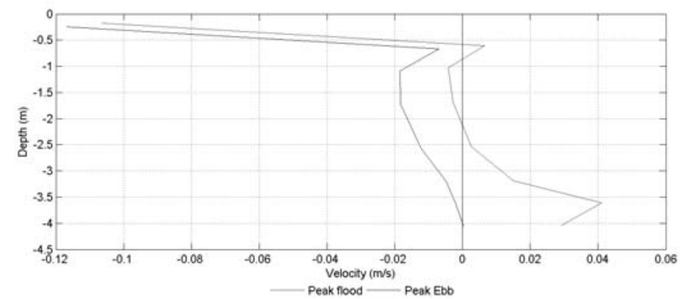


Figure 5-20: Velocity profiles at harbor entrance (Figure 3-12) for a brackish inflow of 0 mgd and a 400 slip new Marina

Salinity

The salinity patterns within the existing Harbor retain a similar structure to those found under existing conditions, as there are not any density changes in the new Marina to affect the structure in the existing Harbor (Figure 5-21 and Figure 5-21). However, in the surface layers towards the ocean side of the Harbor, the water is slightly more saline due to the fact that the low salinity water is entering the new Marina and is not all continuing out in the surface layers to the ocean.

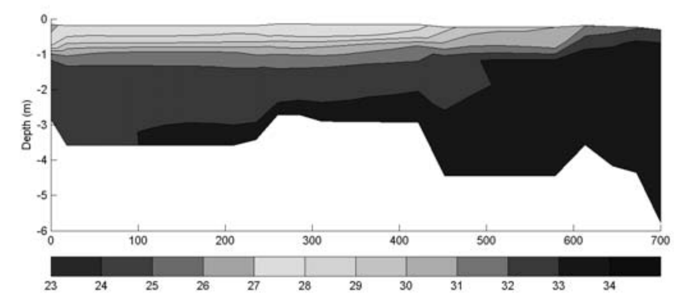


Figure 5-21: Salinity at peak flood (ppt) along Transect EH (Figure 3-12) at high tide for Case 1

The salinity contours within the new Marina show that the main body of water within the new Marina is highly saline (Figure 5-22). Only a small amount of brackish water found at the surface near the intersection of the two harbors is present. This brackish water is moving toward the back of the new Marina as shown in the previous section.

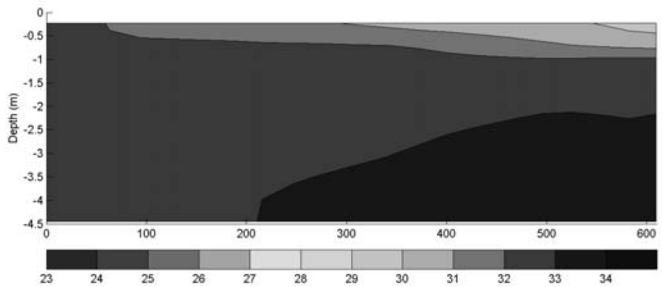


Figure 5-22: Salinity contours at peak flood (ppt) along Transect NM (Figure 3-12) for Case 1

Chlorophyll a

Chlorophyll a concentrations within the existing Harbor at high tide are shown in Figure 5-23. These values are fairly high at the back of the existing harbor. They retain the same depth trend as is shown under existing conditions. The chlorophyll a concentrations within the Harbor range from 2 to 5 µg-Chla/L. The mean value that was reported in Section 5.4.2 was 3 µg-Chla/L; however, spatial and depth variability is great. Under existing conditions, the high value was about 0.5 µg-Chla/L.; thus, the degradation of the water quality under these conditions is apparent even with the smaller proposed 400 slip Marina.

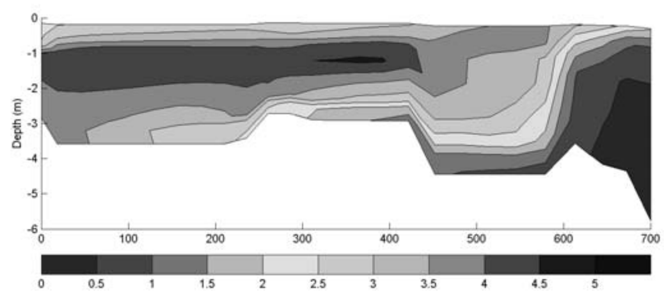


Figure 5-23: Chlorophyll a concentrations at peak flood along Transect EH (Figure 3-12) for Case 1

Within the new Marina, Chlorophyll a concentrations are high in the surface layers toward the middle of the new Marina (Figure 5-30). The nutrients for the algae consumption and reproduction enter the new Marina at the surface layer (coming from the existing Harbor). The algae resist growing near the intersection of the two harbors because the water at the surface is brackish and the more saline environment near the middle of the Marina is favored. Near the back wall, the discharge from the exhibit contains minimal Chlorophyll a concentrations; therefore this area near the wall does not promote as much algae growth.

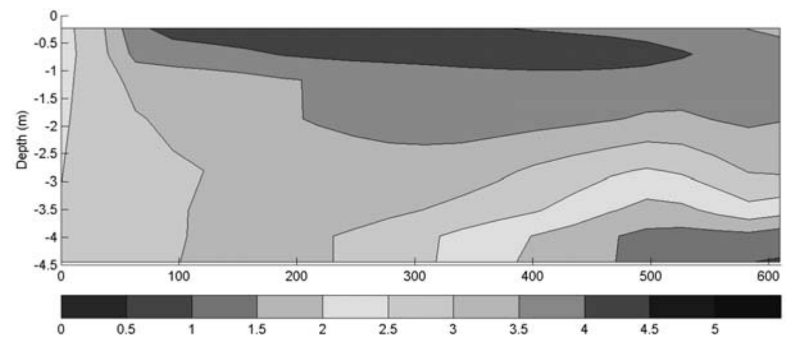


Figure 5-24: Chlorophyll a concentrations at peak flood (µg-chla/L) along Transect NM (Figure 3-12) for Case 1

5.5.2 Case 2: 400 slip new Marina, 30 mgd brackish groundwater inflow, exhibit flow pumped into new Marina.

Currents

The velocity structure with 30 mgd of brackish groundwater flowing into the new Marina develops into more defined (relative to Case 1) two layer structure and exhibits much higher velocities flowing out of the new Marina than were observed in Case 1 (Figure 5-25). This indicates that the new Marina is developing a density current system similar to what is observed under existing conditions in Honokohau Harbor. This is also observed in the flushing time of the new Marina which is shown to have decreased to about 13 hours from the 25 hours observed in Case 1. This is an indicator that overall water quality will be significantly improved within the new Marina, as it is starting to draw in ocean water at higher velocities and push out water in the middle layers at faster velocities.

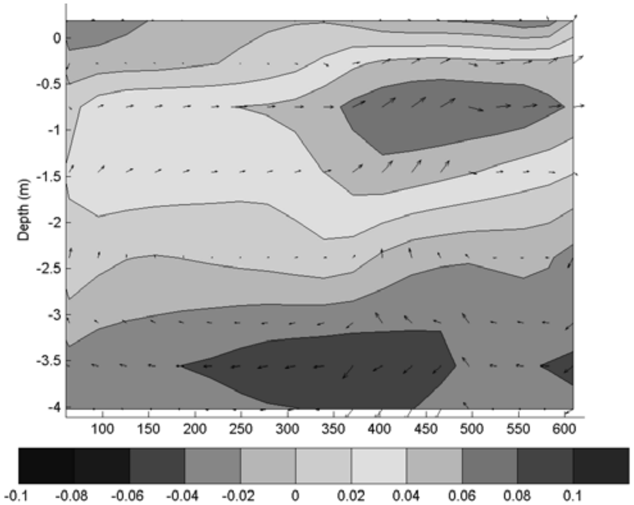


Figure 5-25: Velocities at peak flood (m/s) along Transect NM (Figure 3-12) for Case 2

At the harbor entrance, the velocity profiles at peak flood and peak ebb look similar to those shown in Sections 3.2.6 and 3.3.5; however it should be noted that there is a recurrent inflection in the velocity profiles that is directed out of the Harbor at about 1 to 2 m of depth (Figure 5-26). This is due to the flow that exits the new Marina below the surface layer. This layer also appears to always be directed out of the Harbor during both flood and ebb tide. During peak ebb, there is still flow entering the Harbor system at the bottom layer; however the velocities are not as high as those under existing conditions. This among other factors may contribute to the degradation of the water quality within the existing Harbor.

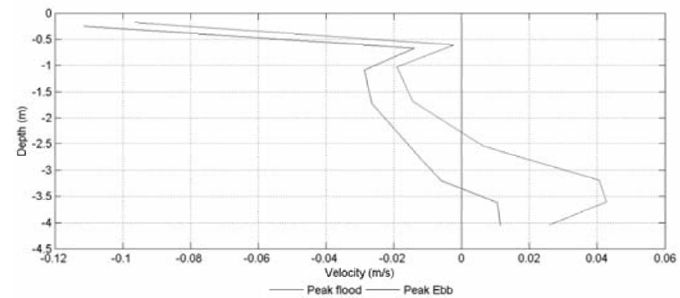


Figure 5-26: Velocity profiles at harbor entrance for a brackish inflow of 0 mgd and a 400 slip new Marina

Salinity

The salinity profiles within the existing Harbor appear similar to those shown in Figure 3-18. It is of note that the salinity in the back end of the existing Harbor is slightly more brackish (Figure 5-27), and that the contours extend further down in the water column. This is of note because it indicates that the nutrient-laden brackish water that under existing conditions is confined to the surface water is mixed into the lower layers, creating a more suitable environment for algae growth.

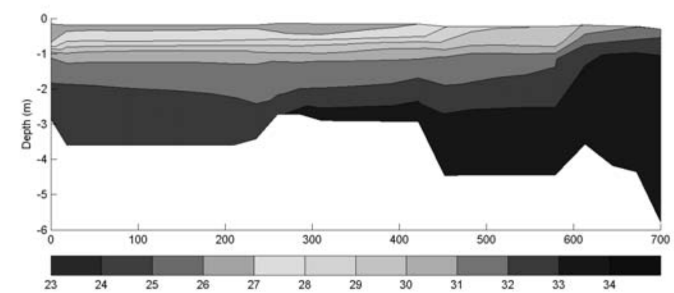


Figure 5-27: Salinity at peak flood (ppt) along Transect EH (Figure 3-12) at high tide for 0 mgd brackish water inflow and 400 slip new Marina

Salinity within the new Marina is much more stratified than in Case 1. This induces more density driven flows into and out of the new Marina.

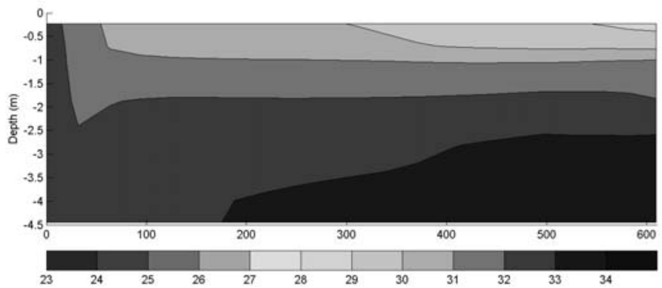


Figure 5-28: Salinity contours at peak flood (ppt) along Transect NM (Figure 3-12) for Case 2.

Chlorophyll a

Within the existing Harbor, there is a wide range of Chlorophyll a concentrations. While the value reported as the mean value for the entire Harbor was 1.5 µg-chla/L, it is seen in Figure 5-29 that the values within the existing Harbor range from almost zero to almost 4 µg-chla/L. However, it is also noted that this range is much more variable and tends to be lower than that found in Case 1. This indicates that more of the nutrients and algae are moved out of the system. It still appears that not enough ocean water is pumped through the system. This is evidenced by the lower salinities in the deeper parts of the back basin. More nutrients are remaining in the system, and the algae growth in the back of the existing Harbor is higher than in the rest of the system. It was also shown in previous sections that pumping the saline exhibit water into the existing Harbor also significantly increases the mixing within this Harbor.

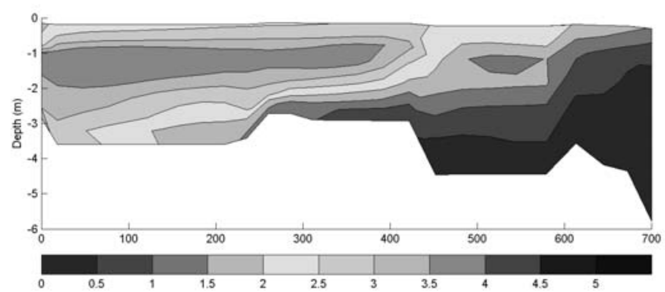


Figure 5-29: Chlorophyll a concentrations at peak flood (µg-chla/L) along Transect EH (Figure 3-12) for Case 2.

Chlorophyll a concentrations within the new Marina are very low, with only slightly higher concentrations near the intersection of the existing Harbor (Figure 5-30). This indicates that 30 mgd of brackish water appears to be significant enough to flush this marina adequately enough to prevent significant algae growth. It also indicates that the new Marina may be intercepting more ocean water that is drawn into the existing harbor under existing conditions.

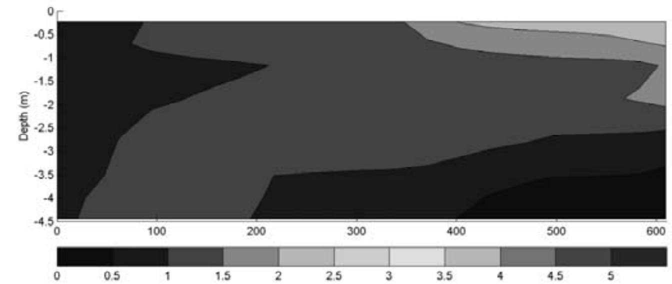


Figure 5-30 Chlorophyll a concentrations at peak flood (µg-chla/L) along Transect NM (Figure 3-12) for 0 mgd brackish water in 400 slip Marina

6. EFFECT ON SURROUNDING COASTLINE

The hydrodynamic and water quality model described in Chapters 3 and 4 was developed and calibrated to reproduce existing conditions in the Honokohau Harbor and future conditions in the new Marina system. Although the model reproduces the velocities and water level variation under tidal conditions at Honokohau Bay, it has not been calibrated to reproduce accurately the salinity distribution or water quality in that area. Water quality model calibration at Honokohau Bay was not considered part of this study mainly due to the scarcity of oceanographic and water quality data and most importantly the unavailability of data regarding groundwater brackish water inflows into the ponds and through the coastline and anchialine ponds. In order to calibrate the water quality model including Honokohau Bay, a comprehensive data collection effort together with a thorough groundwater study would be necessary.

Because the coastal area north of Honokohau Harbor (Honokohau Bay) is important due to its coral populations as well as its proximity to Kaloko-Honokohau National Historical Park and its existing pristine natural state under the state's Class AA designation, the numerical model has been used to estimate possible changes from existing water quality conditions in Honokohau Bay due to the development. The nutrient concentrations in this region are important to the National Park Service and it is necessary that nutrient concentrations within the region conform to state standards for the Class AA pristine climate that exists currently. Note that results presented in this section should be used with caution. They provide an approximate measure of relative changes in water quality conditions caused by the new marina development.

Due to the previously explained limitations in model predictability, the effect of the new development in the water quality of the surrounding coastal areas cannot be estimated in absolute terms from the simulations, as the water quality model was not calibrated for these areas. As it was already mentioned, determining the quantity and quality of the groundwater discharged at specific locations along this coastline was beyond the scope of the study, and while coastal groundwater brackish inflows along the coastline were included, their amounts and also nutrient concentrations were approximated and not directly observed. Therefore, the changes that occur at neighboring areas of Honokohau Bay due to the introduction of the proposed Kona Kai Ola Marina are represented as relative changes from the existing conditions. For all sections and comparisons, plots are provided showing the relative difference (termed *Diff*) in concentration from existing conditions, be it a negative or positive difference. This was calculated using the tidally average mean value of the concentration, C_a, such that,

$$Diff = \left(C_{avNEW} - C_{avEXIST}\right) / C_{avEXIST}$$

The scenarios tested were compared in the previous section in the area just outside of the Harbor entrance to examine how the nutrients are diluted in this region. Both surface changes and bottom changes are shown in order to demonstrate the stratification of the system and the effects on the benthic and coral populations. Due to the fact that the large 800-slip marina results in significant water quality degradation, the analysis of the offshore effects is neglected for this alternative.

6.1 Depth Averaged Velocity

Bilger and Atkinson (1995) state that the nutrient uptake rate of a coral reef population is related to the velocity near the bed. Therefore, examining the impact of the proposed marina on velocities through the entrance channel of the Harbor is necessary.

In order to examine the effects of the proposed Marina on the nutrient uptake rate, the relative increase in velocities in the offshore region of coral populations were analyzed. The existing depth averaged velocity magnitudes in this region are shown in Figure 6-1. The changes associated to the additional marina are three-fold. First, there is an increase in tidal prism due to the expanded volume, which increases the flow through the Harbor entrance. Second, there is an unknown quantity of additional brackish groundwater that will be intercepted by the new Marina. Third, there is the potential of exhibit water discharge in the system. All of these effects serve to increase velocities through the entrance channel; however the simulated velocities remain relatively small

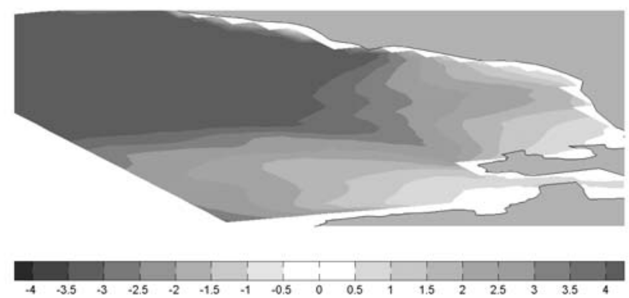


Figure 6-1: Depth averaged velocities (cm/s) under existing conditions

The increases are shown in Figure 6-2 for cases with exhibit flow included. It is shown that increases in depth averaged velocities are most pronounced in the Harbor mouth and dissipate quickly after exiting the Harbor. The figures in this section are based on relative differences. The numbers shown are meant to indicate fractional increase or decrease. The increase in velocity when including the exhibit flow is about 1.6 times the amount of the existing flow, so there is about a 1.6 cm/s increase in depth-averaged velocity through the entrance channel. This includes only the effects of the increased tidal prism and the additional exhibit water. When additional brackish inflow is accounted for, the depth-averaged velocities continue to increase by about 3 times the existing velocity, or 3 cm/s. This would result in depth-averaged velocities of about 4 cm/s through the entrance channel. It is noted that these velocities are influenced only by tidal and discharge effects. Velocity effects due to waves and oceanic currents could be fairly significant especially during seasonal events, in which case, the change due to the additional discharges and tidal prism would be less significant.

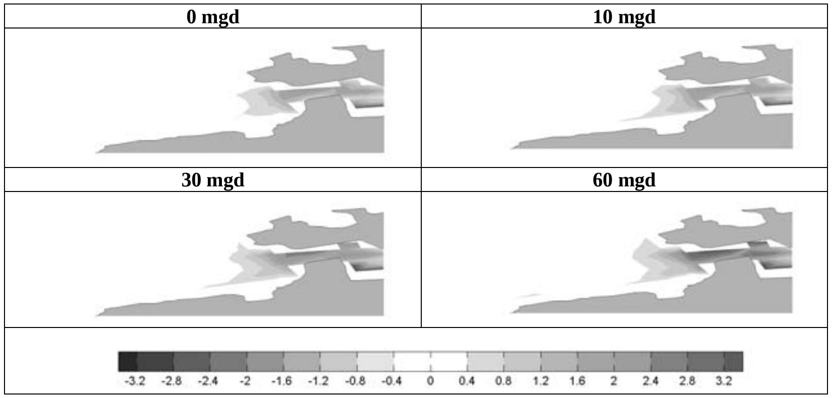


Figure 6-2: Relative increases in depth averaged velocity with exhibit water included

This increase in velocities is somewhat limited when the exhibit discharge is excluded (Figure 6-3); however the increased tidal prism and the additional brackish inflow continue to affect the velocities. In the case where there is not any additional brackish inflow and not any exhibit inflow, the increased tidal prism is the only factor affecting the velocities, and it appears that this effect alone causes an increase in depth-averaged velocity of about 0.8 to 1.2 cm/s (about 1x existing conditions higher velocities). However, it appears that when the exhibit water is excluded the effects on the depth-averaged velocities are more confined to the entrance channel and do not extend far from the Harbor mouth. This is likely to be important as it will control the surface area of coral that may be affected by the increased velocities.

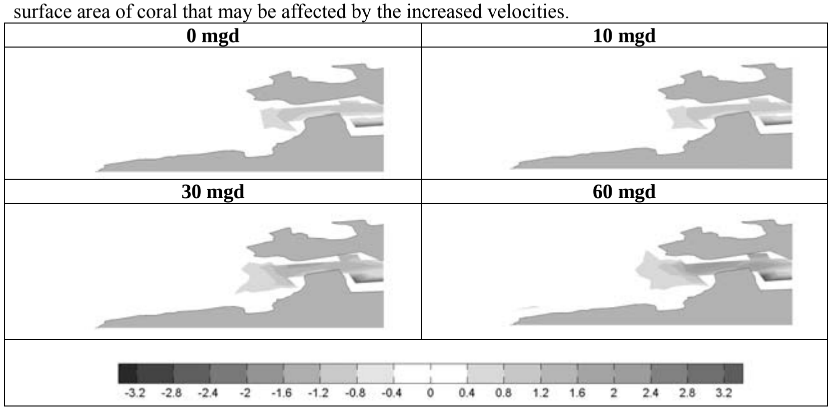


Figure 6-3: Relative differences in depth averaged velocity with exhibit water excluded

It is not possible to extrapolate exactly how the nutrient uptake rates in the area will be affected by the increased velocities. Bilger and Atkinson (1995) conducted their experiments in an extremely controlled environment, and they were more concerned with higher velocity flow (with tests starting at a minimum depth-averaged flow of 4 cm/s). This effect would have to be studied in more detail to get an accurate picture of the velocity effect on the coral in the area.

6.2 Salinity

The salinity of the waters outside of the Harbor changes by a very small amount both when the exhibit water is included in the model and when it is excluded. Figure 6-4 shows that for the cases with exhibit water included, the salinity at the surface exhibits changes that are very small when the amount of brackish groundwater entering the new Marina is small (<20 mgd). In the cases of 30 mgd and 60 mgd of brackish groundwater inflow, the system tends to become slightly fresher with almost a 4% decrease in salinity in the 60 mgd case.

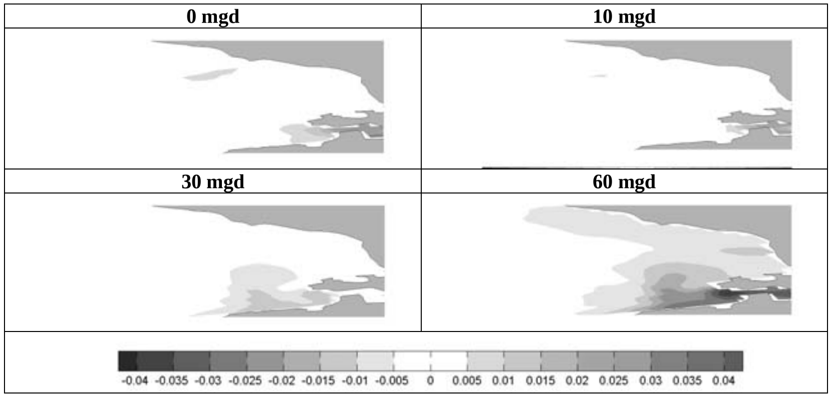


Figure 6-4: Relative salinity changes from existing (fraction) at the surface with exhibit flow included

Changes near the bottom outside the Harbor are even smaller, with maximum change being a reduction of about 1% along the shallow area of the Park coast at 60 mgd of brackish inflow. This indicates that the changes in salinity due to the brackish inflow are mainly confined to the surface layers, and that in the deeper waters away from the coast, the changes are extremely minimal near the bottom. This indicates that salinity conditions for the coral populations outside the harbor should remain similar to existing conditions post-expansion.

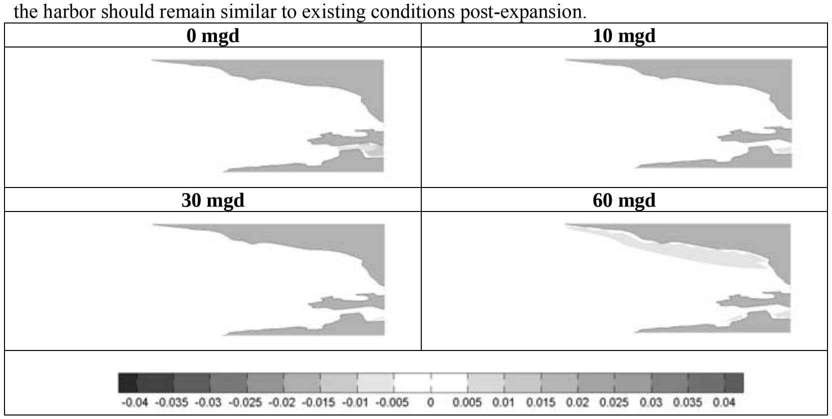


Figure 6-5: Relative salinity changes from existing (fraction) at the bottom with exhibit flow included

When the exhibit waters are excluded, the waters surrounding the Harbor show slightly more change than when the saline exhibit waters are included (Figure 6-6).

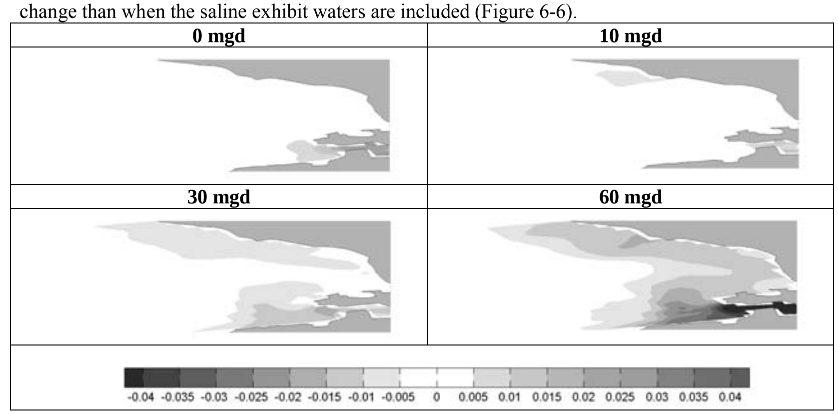


Figure 6-6: Relative salinity changes from existing (fraction) at the surface with exhibit flow excluded

For brevity, relative changes in salinity at the bottom with exhibit flow excluded are not displayed. Changes are within 0.005 ppt of existing conditions for all cases, indicating that changes in salinity are insignificant in the bottom layers without the exhibit inflow.

6.3 Nutrients

6.3.1 Nitrate-nitrogen

All nutrients (NO_3-N, o-P, and NH_4-N) follow similar trends in their exit from Honokohau Harbor; however, the levels of nitrate are most concerning, as the current conditions already exceed standards both within Honokohau Harbor and outside the Harbor. Figure 6-7 shows the relative additions to the nitrate-nitrogen concentrations in the vicinity of the Harbor when the exhibit outfall into the system is included. It shows that in the conditions with less brackish groundwater inflow, the concentrations in the vicinity of the National Park are less than current conditions. For the case with 30 mgd of additional brackish inflow, the concentrations are about 10 to 20 percent greater With 60 mgd, the concentrations can increase to 40 percent greater than current conditions. According to values reported by Ziemann in the area, nitrate-nitrogen concentrations range from about 300-900 µg-N/L at the surface. Therefore these increases of 10% are fairly small (<10 µg-N/L). It is worth noting that state standards mandate that Class A waters maintain a mean concentration of 8 µg-N/L.

Bottom concentrations follow similar trends (Figure 6-8) as the surface concentrations with concentrations decreasing with lower groundwater inflow, and increasing with higher groundwater inflow. The higher increases and decreases in concentration tend to be near the coastline of Kaloko-Honokohau National Historical Park. This is likely due to the shallow waters there which allow for nutrients confined to the surface layers mix into the bottom layers.

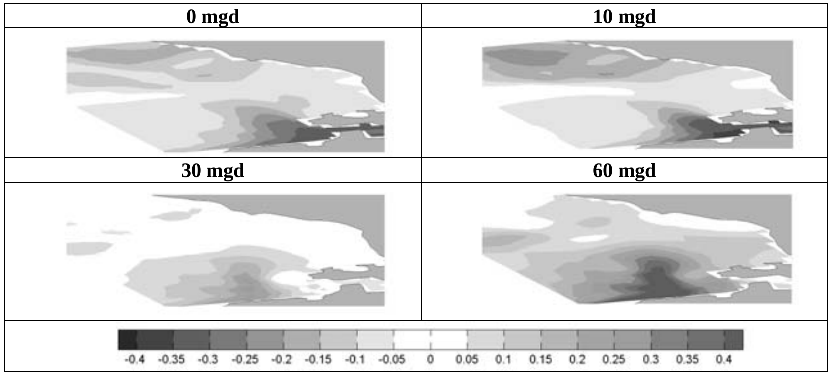


Figure 6-7: Relative additions in nitrate-nitrogen concentrations at the surface with exhibit flow included

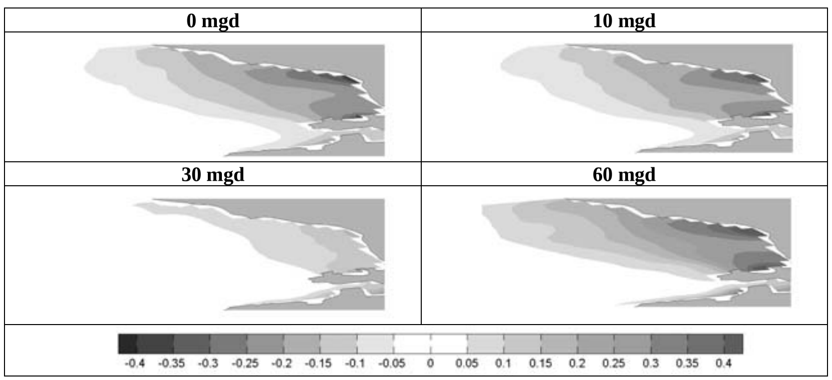


Figure 6-8: Relative additions in nitrate concentrations near the bottom with exhibit flow included

The outfall of the exhibit water into the marinas is shown to introduce a significant ammonia-nitrogen load to the system. This can also affect nitrate-nitrogen levels because in high oxygen environments, ammonia-nitrogen will convert to nitrate-nitrogen. This can be seen in Figure 6-9 and Figure 6-10, which show that concentrations outside the Harbor do not start to increase until 60 mgd of brackish groundwater are introduced to the system when the exhibit outfalls are excluded.

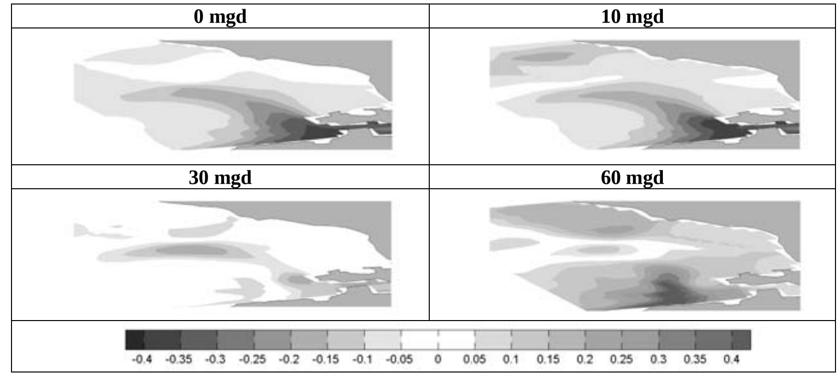


Figure 6-9: Relative additions in nitrate concentrations near the surface with exhibit flow excluded

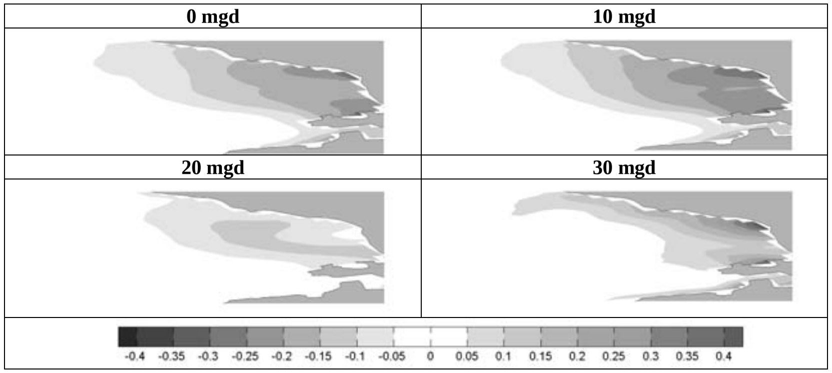


Figure 6-10: Relative additions in nitrate concentrations near the bottom with exhibit flow excluded

6.3.2 Ammonia-nitrogen

While the other nutrients are almost entirely dependent on the inflowing brackish groundwater, ammonia-nitrogen is introduced by the exhibit waters and is therefore more variable based on the alternative selected. Figure 6-11 shows the relative changes of ammonia-nitrogen outside of the Harbor at the surface with the inclusion of the exhibit flow. It is seen that in the surface waters, the highest impact occurs offshore of the Harbor, with fewer impacts near the Park coast.

Higher ammonia-nitrogen concentration levels are found in the cases with the greater amounts of brackish discharge at the surface occurs when the brackish water flowing from the new Marina is sufficiently light to mix with the ammonia from the exhibit waters and still flow out of the Marina.

The impacts in the near the bottom outside of the Harbor are more pronounced along the coast, with higher brackish discharge causing ammonia-nitrogen in the bottom layers. Also in these shallow areas, nutrients that are normally confined to the upper layers of the water column can potentially be mixed into lower layers in this region due to its shallow nature. As was shown in earlier sections, the Harbor flushing is faster when more brackish groundwater is intercepted, resulting in improved water quality. While this effect is beneficial for the Harbor waters, it results in a relative increase of nutrient loads on coastal waters increase when the water is flushed out of the Harbor.

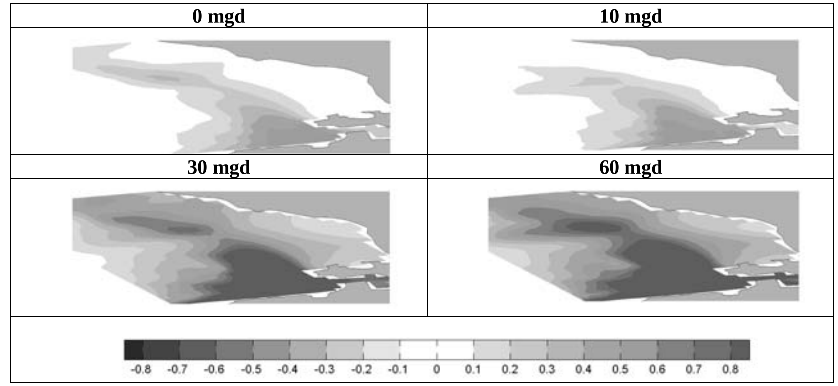


Figure 6-11: Relative ammonia-nitrogen changes from existing at the surface with exhibit flow included

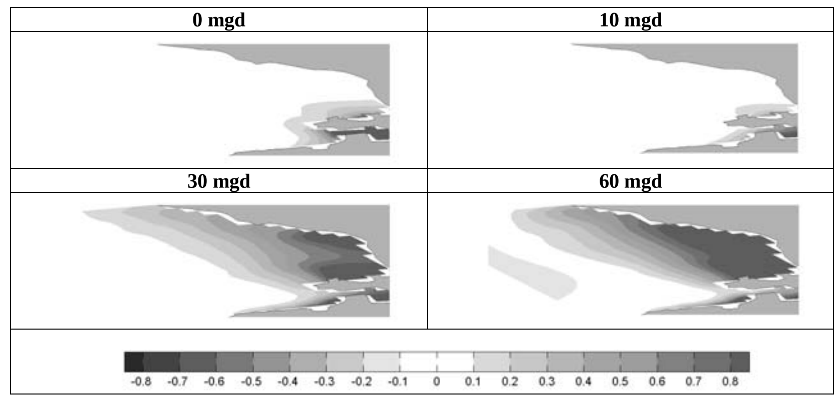


Figure 6-12: Relative ammonium-nitrogen changes from existing at the bottom with exhibit flow included

When the exhibit discharge is not considered as an input to the model, the results show that the trends of the ammonia-nitrogen concentrations follow what is shown with the nitrate-nitrogen concentrations. This is due to the fact that in this case, the main input of ammonia-nitrogen and nitrate-nitrogen is from the brackish groundwater. The results indicate that when exhibit water is not included, the relative increase is less than when exhibit water is included. This is important as the uptake of ammonia-nitrogen by coral is greatly influenced by the ambient concentrations in the bottom layer as well as the velocity effects discussed earlier.

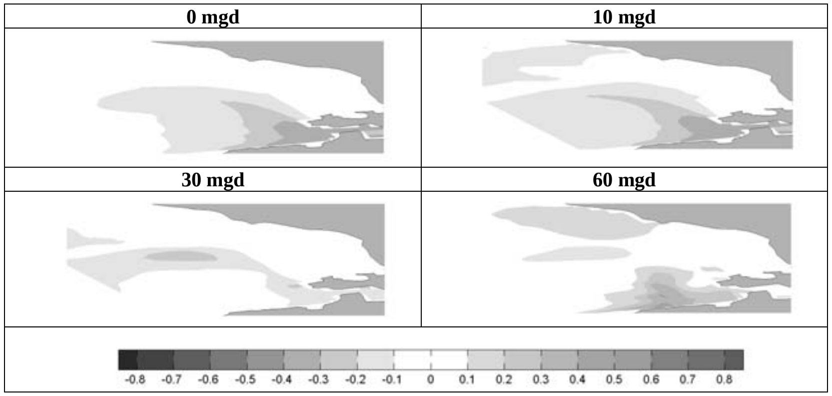


Figure 6-13: Relative ammonium-nitrogen changes from existing at the surface with exhibit inflow excluded

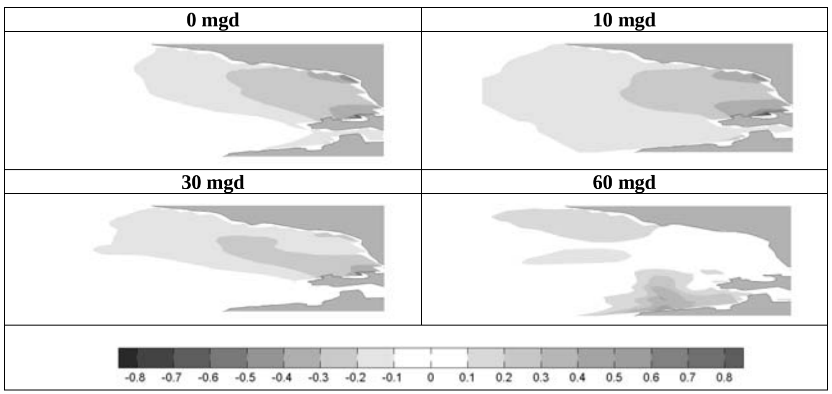


Figure 6-14: Relative ammonium-nitrogen changes from existing at the bottom with exhibit flow excluded

6.3.3 Chlorophyll a

Chlorophyll a concentrations along the coastline of Kaloko-Honokohau National Historical Park are of importance, as algal blooms and invasive algae species have been shown to be detrimental to benthic and coal communities. Current state standards mandate that concentrations within the

Honokohau Bay have a mean value less than 0.3 µg-chla/L. Ziemann (2006) reported chlorophyll levels along Transect B in the range of about 0.2 µg-Chla/L to about 1.5 µg/L, indicating that in this time period, Chlorophyll a concentrations were mainly above standards. Figure 6-15 and Figure 6-16 show the relative increase of the Chlorophyll a concentrations with the addition of the new Marina for the surface and bottom layers respectively. It is seen that surface concentrations increase much more dramatically than the bottom concentrations, especially when brackish groundwater is low and the marina system flushing is slow. This allows more algae to grow in the quiescent waters of the marinas before being released from the harbor mouth. As brackish inflow through the new Marina increases, the production of algae decreases due to the more rapid flushing out of the Harbor into more expansive waters. It can be seen that the concentration can increase by four-fold in some cases.

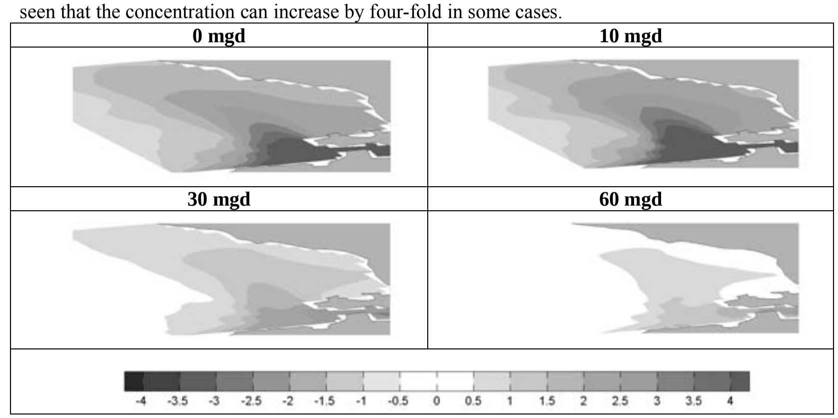


Figure 6-15: Relative increases in Chlorophyll a concentrations at the surface with exhibit inflow included

Concentrations in the bottom layers do not increase by the same relative amounts as the surface changes because of light restrictions and less available nutrients (Figure 6-16). However in the cases of lower brackish inflow, the increases can be on the order of the existing concentrations.

Simulation results indicate that when the exhibit water is not included (Figure 6-17 and Figure 6-18), the increase in Chlorophyll a production appears to be slightly higher than experienced with the diluting exhibit water.

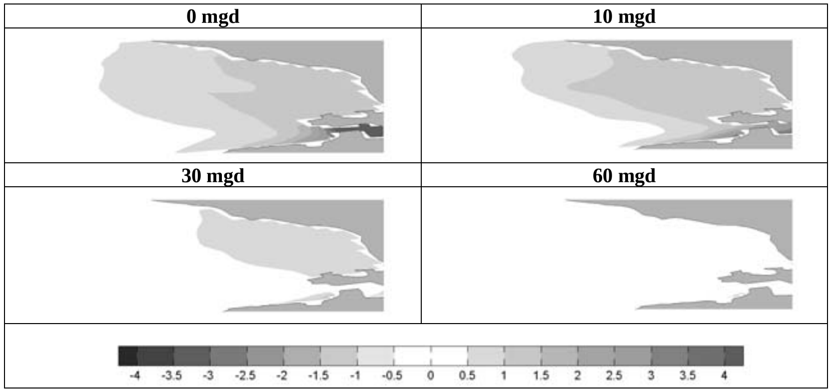


Figure 6-16: Relative increases in Chlorophyll a concentrations at the bottom with exhibit inflow included

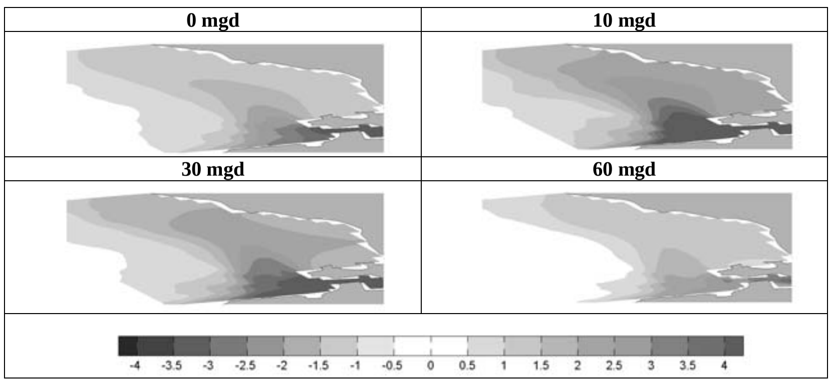


Figure 6-17: Relative increases in Chlorophyll a concentrations at the surface with exhibit inflow excluded

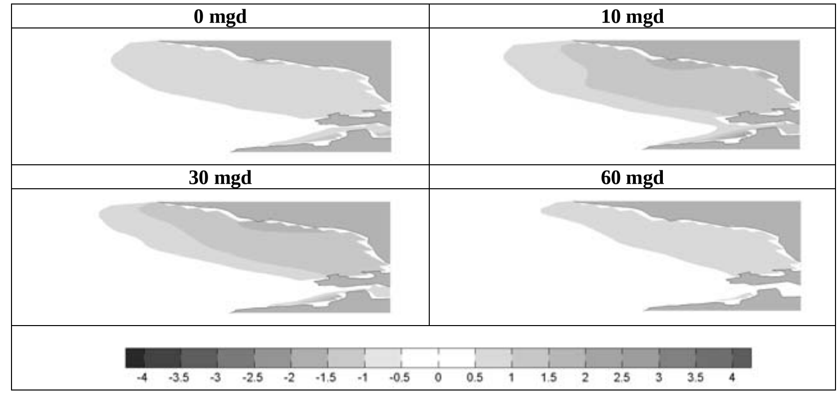


Figure 6-18: Relative increases in Chlorophyll a concentrations at the bottom with exhibit inflow excluded

6.3.4 Conclusions

Due to the increased tidal prism, exhibit inflow, and additional brackish inflow, the flow through the harbor entrance is expected to increase significantly under post-expansion conditions. Depth-averaged velocities through the harbor entrance can be increased by up to 4 times the existing conditions. This increase in velocities is limited to the harbor entrance, and changes outside of this area are not observed. Salinity differences in the surface and bottom are minimal in cases including and excluding exhibit flow.

Relative changes in nutrient concentrations at the surface tend to be higher than the changes at the bottom. When the exhibit flow is included nitrogenous nutrients tend to be higher outside of the Harbor and changes extend into the bottom layers. When the exhibit flow is excluded, the changes in nutrient concentrations tend to remain more confined to the surface layers. With higher brackish inflows, the nutrients also tend to remain more in the surface layers. Higher rates of brackish inflows lead to more nutrient inflow to the system and increases in concentration.

Change in algae growth tends to remain confined to the surface layers. Relative changes can be up to 4 times the existing concentrations. With higher brackish inflow, change in algae growth remains closer to existing conditions in both the surface and the bottom. Waimea Water Services report (2007) states that brackish groundwater entering the new Marina will be significant, so it is expected that post-expansion conditions will resemble the conditions presented for the cases with 30 mgd or higher.

7. SUMMARY AND CONCLUSIONS

The hydrodynamic and water quality existing conditions in Honokohau Harbor were analyzed with existing data sets and a numerical model. This unique system was found to be extremely complex and dependent on the high flushing rate observed under existing conditions. .

The modeled existing water quality conditions within Honokohau Harbor were compared with baseline values reported prior to the construction of the Phase II extension. Overall, Honokohau Harbor has experienced significant improvement from the baseline conditions (1980) to 1991, with corroboration from the 2006 survey (Ziemann, 2006). The concentrations of benchmark parameters NH_4 and o-P have decreased significantly since 1980, with consequent decreases in algal growth (CHLa) and DO deficit. While brackish groundwater inflows remained fairly constant in flow and concentrations, nitrate and silica concentrations increased from 1980 to 2006 in the Harbor. These increases may be attributable to lowered algal populations in the current phosphorous-limited (phosphorous-starved) system, which effectively reduces uptake of NO_3-N and silica, allowing Harbor water column concentrations to increase.

The cause of the DO sag within the Harbor at several sites (mid-Harbor and Front Berthing Basin) may be intermittent wastewater sources, which provide oxygen-demanding carbon and nitrogen loads, as well as plant nutrients. There are insufficient data to quantify the loads or to determine whether they are carbonaceous or nitrogenous. Furthermore, the nutrient data presented by (Bienfang, 1980 and OI, 1991) have very high coefficients of variability (>20%) so that the sampling stations may not be characterized sufficiently for calibration purposes.

The quantity and rate of brackish groundwater entering the existing system has been found to be important. The groundwater's high nutrient loads can be countered only by the high rate of flushing which occurs due to the density currents (low salinity water rising to the surface and flowing out of Honokohau Harbor) created by the groundwater inflow. It was found that maintaining this high rate of flushing is imperative to maintaining the water quality within the proposed system..

A hydrodynamic model was constructed and calibrated using the Delft3D integrated modeling system. This model was calibrated to existing data and applied to examine the hydrodynamic conditions within Honokohau Harbor and the surrounding areas. In addition, the model was extended to include the proposed Kona Kai Ola Marina, post-expansion conditions were examined. The quantity of brackish groundwater entering Kona Kai Ola Marina that was simulated in this study is not necessarily representative of the actual conditions that will occur upon construction of the new Marina. Instead, a range of possible values that could be expected to occur based on the available information were simulated. It is expected that the quantity of brackish groundwater into the new Marina will be significant as it has been reported by Waimea Water Services (2007) who conducted a groundwater survey and study of the project area.

It was found that the construction of the new 800-slip Marina as described in the Conceptual Master Plan causes the flushing time to increase significantly due to its large volume. This is potentially detrimental to the water quality conditions within the Harbor. It was also found that the circulation in the two harbor system is complex and contains significant internal circulation, which limits the existing Harbor's exchange with ocean waters. Under future conditions, the two

layer density driven system is affected, and during the peak ebb flow, there is not any inflowing water due to the large volume of water moving out of the system through the harbor mouth. In addition, the velocities through the harbor mouth are increased in magnitude by up to 4 cm/s during flood tide.

The hydrodynamic model was coupled with a water quality model developed for the observed conditions within Honokohau Harbor. This model was calibrated with data obtained from OI Consultants (1991) and was validated with data from Ziemann (2006). The model's calibration was within an acceptable range for all nutrients and chlorophyll a values. The calibrated model was applied to simulate future conditions including the new Marina included in the Conceptual Master Plan with 800 slips, which consisted of several possible brackish groundwater inflow rates and included the nutrient loads coming from the exhibit areas. The results show that even under the most advantageous flushing scenarios, the water quality within the existing and new Marinas is projected to decrease significantly. Elevated chlorophyll a concentrations persist outside the Harbor. This is primarily due to the decreased flushing of the Harbor post-expansion.

Based on the aforementioned results, it can be concluded that since the 800-slip marina from the Conceptual Master Plan cannot maintain existing water quality conditions it should not be given further consideration. Only if the additional brackish groundwater inflow into the new marina is determined to be greater than 60 mgd, the option of an 800 slip marina could be reevaluated

Alternatives to the Conceptual Master Plan

In order to minimize the effects of the proposed project, different design parameters could be investigated. The EPA's recommended Best Management Practices for increasing flushing of Marinas suggest a number of different options (EPA, 2001: Section 4.1).

- Changing the size or shape of the entrance channel,
- Adding more than one entrance channel,
- Using mechanical aerators in problem areas,
- Optimizing the geometry such that there are as few separated basins as possible, and
- Altering the size of the planned Marina.

In addition, due to the unique conditions experienced in the project area, alternatives associated with the inclusion and positioning of the water exhibit inflow was also considered. Within the conditions of the modeling effort, the alternative considered consists of decreasing the size (volume) of the new Marina to 400 slips (25 acres). Based on numerical model simulations, reducing the Marina volume proved to be an important factor in maintaining water quality conditions in the new marina system independently of the volume of brackish groundwater that will be intercepted by the new Marina. The positioning of the exhibit inflow also seems to affect the water quality within and outside of the marina system.

A formal solution to the proposed system is not attainable without an accurate picture of the brackish groundwater inflow to the system. The interception of large quantities of groundwater tends to increase the flushing through the harbor system which leads to more pristine conditions and less algae growth within the harbor system. This should be considered a likely post-expansion condition based on the study conducted by Waimea Water Services (2007).

Specific water quality results obtained from the 400–slips marina configuration are presented below:

1. Post-Expansion Water Quality Conditions Inside the Marina System

- Existing conditions of nitrate-nitrogen concentrations exceed standards within Honokohau Harbor and concentrations will remain similar in the existing Harbor but could improve in the new Marina due to dilution.
- Ortho-phosphate concentrations are within standards under existing conditions and they will remain similar in both marinas.
- Ammonia-nitrogen concentrations, which are within standards under existing conditions, could increase in the marina where the exhibit flow outfall is placed. This effect could be reduced by reducing the ammonia-nitrogen concentration in the exhibits flow, by reducing the amount of animals in the exhibit (pers. comm. Cloward H2O, 2007 and documented in Appendix D)
- Regarding concentration of Chlorophyll a, conditions for all simulated cases with the 400 slip marina remain within oligotrophic limits. Results showed that the chlorophyll a concentrations could remain within the Class A standards for a 400 slip marina, with the exhibit flow into the new Marina and if the additional brackish groundwater inflow into the new Marina is greater than or equal to 30 mgd, which is the same amount entering Honokohau Harbor under existing conditions.

As previously mentioned, considering the findings from Waimea Water Services (2007) stating that the "proposed marina would exhibit the same or similar flushing action" than the existing marina, and based on the results of the simulations presented in this report, it is expected that the new 400 slip marina will capture more than 30 mgd of brackish water in order to show this flushing behavior. Under these conditions and based on the numerical water quality simulations, water quality conditions in the two marina system, outside of the Marina and at Honokohau Bay will remain very similar to existing conditions. In the case that after construction, the new marina would not show the same flushing behavior as the existing marina Waimea Water Services (2007) suggests a mitigation alternative that it would be possible to enhance the inflow into the new marina by drilling bore holes in the floor of the marina in order to reach the adequate flushing.

2. Post-Expansion conditions outside of the Harbor Mouth

In general, NO_3-N, o-P and NH_4-N concentrations outside of the Harbor mouth after the new Marina construction are expected to be in the same order to those observed under existing conditions. However, Chlorophyll a concentrations appear to be consistently higher than Class AA standards; however they decrease for all cases below the standards for Class A waters. Due to the area's proximity to the Harbor entrance, this may still remain acceptable as long as the algae dies and is diluted within a reasonable distance from the Harbor mouth.

Depth averaged velocities are increased through the Harbor entrance channel by up to 4 cm/s (with a 400 slip marina); however, this increase is confined to a small area immediately surrounding the Harbor entrance.

3. Post-Expansion Water Quality Conditions at Honokohau Bay

Conditions outside of the Harbor were examined briefly, however definitive conclusions based on model results cannot be drawn due to the fact that the model was not calibrated for this region. Results can be used to determine trends of the surrounding areas. The changes in nutrient concentration vary based on the quantity of brackish groundwater. Inclusion of the exhibit waters with the simulated nutrient loads causes a significant difference in ammonia-nitrogen concentrations throughout the Bay, extending into the bottom layers in some cases. The differences in Chlorophyll a concentrations were such that they allow the areas of concern to still remain oligotrophic. In order to develop a fully calibrated model for this region, extensive data collection for calibration and validation would be needed. It was found that the significance of the brackish inflow into Kona Kai Ola Marina also has an effect on the surrounding waters. The concentrations of nutrients in low flow scenarios are relatively less than existing conditions due to the lack of additional nutrients to the system. However, with higher brackish inflow, the growth of algae is more contained.

The results obtained for the 400-slips marina suggest that if the additional brackish groundwater inflow into the new Marina is greater than or in the order of 30 mgd and reducing the ammonia-nitrogen load in the exhibit water, the water quality conditions at both marinas, the harbor entrance and Honokohau Bay will be very similar to the actual conditions.

It is also worth noting, that the following assumptions were considered reasonable and necessary to implement the model:

- The wastewater treatment plant adjacent to the project site would be upgraded to tertiary treatment without discharging directly into the groundwater.
- Measures will be taken to avoid any point or non-point sources entering the marina system, since they could modify the water quality predictions presented in this study.
- Neither waves, ocean currents, nor extreme hydrodynamic conditions were considered.
- Groundwater withdrawals would not affect the brackish inflow to Honokohau Harbor
- The unknown brackish inflow to Kona Kai Ola Marina could be between 0 mgd and 60 mgd.

Due to the uncertainties and assumptions made in the development of the numerical model, it is recommended that a significant monitoring effort be put in place during and following the construction of Kona Kai Ola Marina in order to determine the future ambient conditions and to control any additional inputs not accounted for within the model. Due to the high importance of flushing to maintaining system quality, the post-expansion option suggested by Waimea Water Services (2007) of drilling additional holes in the bottom of the new Marina and the existing Harbor could be used to enhance flushing and improve water quality if needed.

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APPENDIX A – DATA FROM PREVIOUS STUDIES

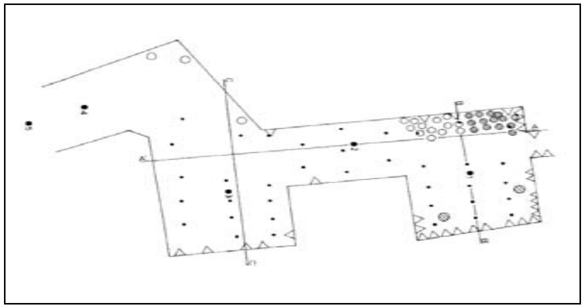

Figure A-1: Bienfang Sampling Locations (1980)

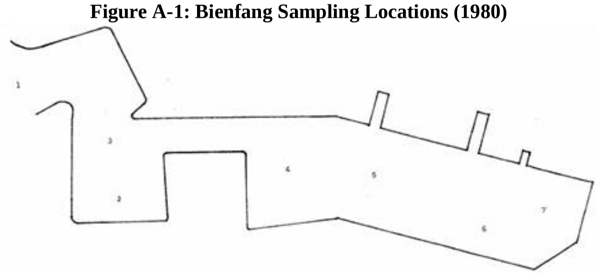

Figure A-2: Bienfang Sample Locations (1982)

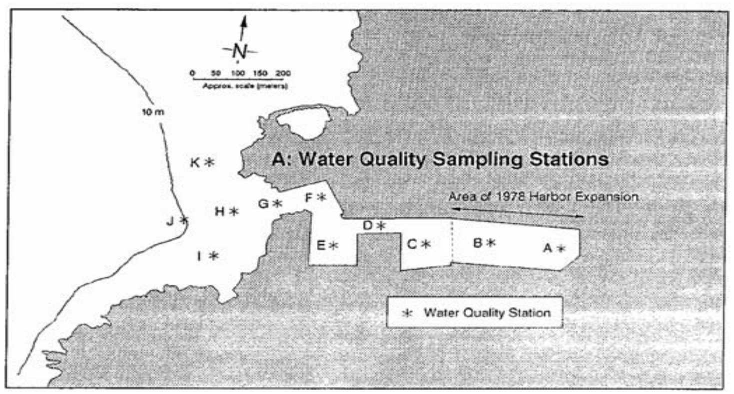

Figure A-3: OI Consultants Sampling Stations (1991)

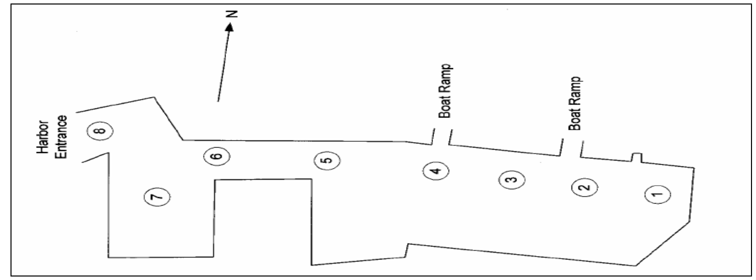

Figure A-4: Ziemann Sampling Stations (2006)

Table A-1: Surface concentrations

Surface

Study	Site	Sample Location Approx.Ziemann	Temp, oC	Sal, ppt	DO, mg/L		DO Deficit, %		NO3, ug-N/L	PO4, ug-P/L	NH4, ug-N/L	Chl, mg/m3	SiO2, ug-Si/L
Bienfang (1980) L	1	4.5	20.5	18.5	4.53		-44		381.8	60.8	18.76	0.10	
Bienfang (1980) L	3	7.0	21.5	30	5.44		-27		329	54.56	16.9	0.1	
Bienfang (1980) H	1	4.5	20.5	18.5	4.53		-44		471.2	77.5	7.70	0.06	
Bienfang (1980) H	3	7.0	21.5	30	5.44		-27		322	48.98	7.6	0.1	
Bienfang (1982) L	7	1							425.6	62.62	3.78	1.68	
Bienfang (1982) L	6	2							525	53.94	0.14	3.47	
Bienfang (1982) L	5	4							460.6	41.85	2.66	0.36	
Bienfang (1982) L	4	5							592.83	66.96	0.14	5.02	
Bienfang (1982) L	3	7							296.52	70.06	1.54	2.76	
Bienfang (1982) L	2	8							441.42	57.04	2.66	0.56	
OI (1991) L	A	1	21.42	24.06	5.34		-30		277.8	54.0	14.14	0.07	2891.4
OI (1991) L	B	3	21.65	27.09	5.49		-27		277.7	46.1	5.19	0.62	3157.4
OI (1991) L	C	4.5	21.57	26.00	5.59		-26		179.8	39.7	4.77	0.11	2582.2
OI (1991) L	D	6	21.82	27.02	5.83		-22		121.1	36.1	14.71	0.12	2188.1
OI (1991) L	E	7	22.91	27.74	5.93		-19		313.2	42.4	3.75	0.16	3168.3
OI (1991) L	F	8	22.48	27.75	6.15		-17		226.1	37.9	5.79	0.10	3003.7
OI (1991) L	G		24.21	30.97	5.87		-16		251.7	33.3	6.10	0.17	2879.5
OI (1991) H	A	1	20.88	24.27	5.34		-31		325.2	54.5	7.75	0.07	5149.5
OI (1991) H	B	3	21.78	27.64	5.50		-26		246.8	194.7	6.87	0.65	3447.5
OI (1991) H	C	4.5	21.79	26.77	7.98		6		240.6	169.5	5.79	0.07	2671.9
OI (1991) H	D	6	22.58	27.55	6.45		-13		231.9	167.3	4.95	0.10	3985.3
OI (1991) H	E	7	23.04	27.57	7.46		2		202.2	106.6	3.37	0.12	2206.1
OI (1991) H	F	8	23.87	29.21	6.74		-6		164.7	100.5	4.67	0.12	2764.2
OI (1991) H	G		24.05	31.78	7.15		2		73.5	50.4	4.07	0.32	1351.1
Ziemann (2006)	1	1	24.40	22.60	6.22		-15		660.0	22.0	1.00	0.12	10810.0
Ziemann (2006)	2	2	24.2	21.5	6.35		-14		590.0	28.0	1.00	0.09	10320.0
Ziemann (2006)	3	3	24.4	25.3	6.89		-5		389.0	14.0	1.00	0.22	11220.0
Ziemann (2006)	4	4	25.1	24.9	6.31		-12		218.0	16.0	1.00	0.43	8830.0
Ziemann (2006)	5	5	21.3	25	6.22		-19		520.0	16.0	1.00	0.11	8800.0
Ziemann (2006)	6	6	21.4	26.9	6.24		-17		596.0	22.0	1.10	0.16	7799.0
Ziemann (2006)	7	7	23	26.4	6.8		-8		640.0	27.0	1.90	0.18	9768.0
Ziemann (2006)	8	8	22.9	28.9	6.73		-7		430.0	18.0	1.30	0.20	6738.0

Table A-2: Bottom Concentrations

Bottom

Study	Site	Sample Location Approx.Ziemann	Temp, oC	Sal, ppt	DO, mg/L		DO Deficit, %		NO3, ug-N/L	PO4, ug-P/L	NH4, ug-N/L	Chl, mg/m3	SiO2, ug-Si/L
Bienfang (1980) L	1	4.5	24.5	35	5.83	6.83	-15		53.2	9.9	8.12	0.55	
Bienfang (1980) L	3	7.0	24.5	35	5.18	6.83	-24		6.7	6.5	12.88	0.24	
Bienfang (1980) H	1	4.5	24.5	35	5.83	6.83	-15		53.9	12.1	3.92	0.70	
Bienfang (1980) H	3	7.0	24.5	35	5.18	6.83	-24		17.9	9.9	8.54	0.43	
Bienfang (1982) L	7	1							8.54	11.78	3.78	55.42	
Bienfang (1982) L	6	2							14.7	6.51	4.06	35.27	
Bienfang (1982) L	5	4							11.62	17.05	3.36	15.47	
Bienfang (1982) L	4	5							4.9	3.41	3.78	6.63	
Bienfang (1982) L	3	7							0	16.43	4.06	1.38	
Bienfang (1982) L	2	8							0	4.03	6.16	0.37	
OI (1991) L	A	1	22.25	29.01	5.87	7.35	-20		170.8	36.9	10.03	1.88	2671.0
OI (1991) L	B	3	24.36	32.18	5.81	6.96	-16		140.8	26.7	6.79	3.21	2422.8
OI (1991) L	C	4.5	24.10	31.45	6.41	7.02	-9		129.3	34.1	11.25	6.40	2479.0
OI (1991) L	D	6	24.77	32.31	6.58	6.90	-5		52.6	16.0	5.75	4.44	1493.2
OI (1991) L	E	7	24.82	34.32	6.60	6.82	-3		11.9	9.3	5.33	5.47	471.1
OI (1991) L	F	7	24.75	34.09	6.49	6.84	-5		18.9	9.6	3.47	0.52	742.5
OI (1991) L	G	8	24.65	34.60	6.54	6.83	-4		40.0	7.0	7.64	0.31	734.6
OI (1991) H	A	1	23.62	30.46	8.04	7.12	13		94.5	79.3	8.21	1.44	3519.7
OI (1991) H	B	3											
OI (1991) H	C	4.5											
OI (1991) H	D	6											
OI (1991) H	E	7											
OI (1991) H	F	7											
OI (1991) H	G	8											
Ziemann (2006)	1	1	24.60	29.90	6.52	7.02	-7	8	196.0	16.0	1.00	0.56	6610.0
Ziemann (2006)	2	2	21.3	30.1	6.48	7.434	-13	8	210.0	12.0	1.00	0.25	5010.0
Ziemann (2006)	3	3	24.3	30.7	6.57	7.024	-6	8	404.0	10.0	1.00	0.55	5040.0
Ziemann (2006)	4	4	25.7	30.8	6.59	6.853	-4	8	206.0	12.0	1.10	0.54	5320.0
Ziemann (2006)	5	5	24.3	31.2	6.72	7.004	-4	8	190.0	12.0	2.80	1.16	3704.0
Ziemann (2006)	6	6	23.9	31.6	6.88	7.037	-2	8	240.0	20.0	2.90	0.90	6195.0
Ziemann (2006)	7	7	24.30	32.30	6.83	6.96	-2	8	160.0	10.0	2.20	0.58	2875.0
Ziemann (2006)	8	8	24.2	32.4	7.12	6.968	2	8	120.0	8.0	1.90	0.41	2397.0

APPENDIX B – DESCRIPTION OF FLUSHING TIME CALIBRATION

FLUSHING TIME CALIBRATION

The hydrodynamic model was used to calibrate the dispersion coefficient and the groundwater discharge rate. The data obtained during the dye study that was conducted in March 1991 was used to tune the model.

Residence Time

The concentration of a constituent within an enclosed body of water like a harbor which is dominated by tidal effects can be described by

$$C = C_0 e^{-t/T}$$

Where C_0 is the initial concentration and C is the concentration of the constituent at time t. T is considered to be the flushing time constant or the residence time of the particle. This approach is often referred to as the "e-folding" approach (Monsen *et al*, 2002). The residence time, T, can be considered to be the time required for reduction of a conservative tracer concentration to $1/e$ or 36.8% of its initial value, or a reduction of 63.2%. Mathematically, assuming an exponential distribution of times for individual water particles to reach the ocean, when the concentration of particles reaches 1/e, it represents the average time of all particles to reach the ocean.

If the natural logarithm of the above equation is written as

$$\ln(C) = \ln(C_0) - t/T$$

then it is seen that the natural logarithm of the concentration of a tracer is a linear function of the time with a slope of $-1/T$. In this way, the residence time can be estimated without knowing the initial concentration. This method of computing the residence time was used in the studies conducted by OI Consultants (1991).

Sensitivity Analysis

In this case, to follow the analysis presented in the study conducted by OI Consultants, Inc., the computation of a flushing time constant, T, was used to represent the residence time in the harbor. In order to do this, various combinations of groundwater discharge and dispersion coefficients were chosen to test the model sensitivity. The hydrodynamics for each of these combinations were coupled to a water quality module that was seeded with a conservative tracer up to the mouth of the harbor (Figure 1). This model containing the conservative tracer was then started at the point of last release of the Rhodameine dye at 13:00 March 14, 1991.

Varying the flow rate was found to be important in transporting the substance primarily in the surface layer. For example, when the flow rate was kept at a low value such as 8 mgd which is more consistent with the rates produced by Bienfang (1980) and cited in (OI Consultants, 1991), the model could not transport the substances even out of the surface layer. However using a higher flow rate of 30 mgd, which is more consistent with the rate produced by Gallagher (1980), produces a more reasonable distribution of salinity as well as a flushing time constant consistent with those reported by Gallagher (1980) and OI Consultants (1991) based on measurements within the Harbor.

The field study conducted by OI Consultants (1991) shows flushing time constants within the Harbor to be fairly depth uniform. Dispersion coefficients were varied between 0.1 m^2/s and 1 m^2/s. Independently of the flow rate it was found that using dispersion coefficients at the upper limit promoted too much mixing impacting the salinity gradients throughout the harbor. Using dispersion coefficients at the lower limit caused little to no mixing of the conservative tracer in the lower layers over the three day period. This is not consistent with what was observed in field measurements. Therefore, the dispersion coefficient was calibrated with the flow rate to provide the best results with respect to flushing time throughout the harbor and the salinity gradients that result.

Thirteen cases were tested within the parameters described above. They are presented in Table B-1.

Table B-2: Description of sensitivity cases

Case	Groundwater inflow	Dispersion
1	8	0.1
2	8	0.5
3	15	0.5
4	20	0.1
5	20	1
6	25	0.3
7	25	0.5
8	30	0.3
9	30	0.5
10	30	0.6
11	30	0.7
12	30	0.8
13	35	0.8

In order to compute the residence time for each of these cases, the hydrodynamics under these conditions were used to drive the Delft3D WAQ module. In order to replicate conditions that under the study conducted by OI Consultants (1991), the model was seeded with a conservative tracer with an initial concentration of 1 g/m^3 throughout each depth layer. Outside of the harbor the concentration was set with an initial value of 0 g/m^3. The initial conditions within the harbor are shown in Figure. This model was run at an initial time equal to the time at which the dye injection was completed, 13:00 March 14, 1991. The model was run for a four day period.

Figure B-1: Initial conditions of conservative tracer concentration (red=1, blue=0)

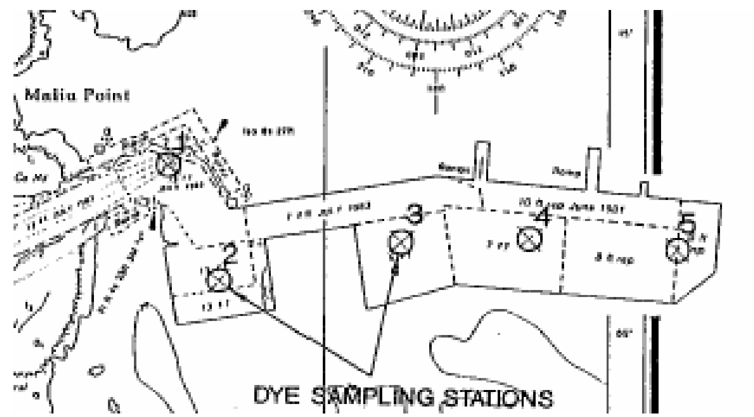

Figure B-2: Dye Sampling stations from OI Consultants (1991)

Using concentration results extracted from the model at each of the five stations shown in Figure B-2, a similar analysis was performed in order to find *T* for depths at the top, middle and bottom of the water column. The results for all tests are shown in Table B-2.

Table B-1: Flushing times

		Station 1	Station 2	Station 3	Station 4	Station 5
Case 1	Top	1.83	1.80	1.77	1.58	1.56
	Middle	2.17	1.60	1.35	0.78	0.84
	Bottom	2.28	2.50	2.27	0.87	0.83
Case 2	Top	0.88	0.89	0.91	0.92	0.93
	Middle	0.87	0.88	0.90	0.78	0.79
	Bottom	0.84	0.77	0.74	0.63	0.68
Case 3	Top	1.28	1.29	1.30	1.23	1.25
	Middle	1.31	1.23	1.29	0.85	0.79
	Bottom	1.17	0.83	0.72	0.51	0.47
Case 4	Top	1.98	1.83	1.71	1.32	1.30
	Middle	3.01	1.62	1.41	0.67	0.67
	Bottom	3.02	2.42	1.49	0.68	0.64
Case 5	Top	0.49	0.49	0.49	0.50	0.50
	Middle	0.49	0.49	0.50	0.48	0.48
	Bottom	0.47	0.47	0.47	0.44	0.46
Case 6	Top	1.06	1.05	1.05	1.02	1.02
	Middle	1.10	1.05	1.04	0.88	0.84
	Bottom	1.06	0.91	0.87	0.79	0.80
Case 7	Top	0.92	0.90	0.89	0.86	0.86
	Middle	0.96	0.92	0.94	0.71	0.71
	Bottom	0.84	0.66	0.61	0.45	0.51
Case 8	Top	1.02	1.02	1.01	0.99	0.98
	Middle	1.05	1.03	1.02	0.90	0.87
	Bottom	1.02	0.91	0.89	0.81	0.83
Case 9	Top	0.86	0.84	0.82	0.79	0.79
	Middle	0.90	0.89	0.89	0.71	0.71
	Bottom	0.79	0.64	0.60	0.46	0.52
Case 10	Top	0.60	0.60	0.60	0.61	0.61
	Middle	0.61	0.61	0.61	0.60	0.60
	Bottom	0.60	0.59	0.58	0.55	0.59
Case 11	Top	0.53	0.53	0.53	0.53	0.54
	Middle	0.53	0.54	0.54	0.53	0.53
	Bottom	0.52	0.52	0.52	0.49	0.52
Case12	Top	0.49	0.49	0.49	0.50	0.50
	Middle	0.49	0.49	0.50	0.48	0.48
	Bottom	0.47	0.46	0.46	0.41	0.44
Case13	Top	0.47	0.47	0.47	0.47	0.47
	Middle	0.47	0.47	0.48	0.46	0.47
	Bottom	0.46	0.45	0.45	0.41	0.44

Note that for tests with small dispersion coefficients (<0.5) the depth variability in the flushing time is high, which can be seen from the standard deviations at each of the stations. Case 4 had the highest variation in depth since it had both a high groundwater flowrate (20 mgd) and a low dispersion (0.1 m^2/s), so that the brackish inflow mainly stayed in the surface layer while not mixing with the saltwater in the lower layer. Both Cases (1 and 4) with dispersion coefficients of 0.1 m^2/s had high depth variation with standard deviations greater than 0.5. The test with the mean flushing time closest to that reported in OI Consultants (1991) and that reported by Gallagher (1980) was the case with 20 mgd groundwater infiltration rate and 1 m^2/s dispersion coefficient. However, this case did not meet salinity show the salinity layers well enough due to too much mixing with the high dispersion coefficient. Therefore, the best case was the case with 30 mgd of groundwater infiltration and a dispersion coefficient of 0.7 m^2/s. This yields a low variation with depth (STD about 0.1) and a mean flushing time of 0.53, which is about 12 hours as reported by Gallagher (1980).

	Station 1	Station2	Station3	Station 4	Station 5	Average Harbor
			Case 1			
Mean	2.09	1.97	1.80	1.08	1.08	1.60
STD	0.23	0.47	0.46	0.44	0.42	0.57
			Case 2			
Mean	0.86	0.85	0.85	0.78	0.80	0.83
STD	0.02	0.07	0.10	0.15	0.13	0.09
			Case 3			
Mean	1.25	1.12	1.10	0.86	0.84	1.03
STD	0.07	0.25	0.33	0.36	0.39	0.31
			Case 4			
Mean	2.67	1.96	1.54	0.89	0.87	1.58
STD	0.60	0.41	0.16	0.37	0.37	0.78
			Case 5			
Mean	0.48	0.48	0.49	0.47	0.48	0.48
STD	0.01	0.01	0.02	0.03	0.02	0.02
			Case 6			
Mean	1.07	1.00	0.99	0.90	0.89	0.97
STD	0.02	0.08	0.10	0.12	0.12	0.11
			Case 7			
Mean	0.91	0.83	0.81	0.67	0.69	0.78
STD	0.06	0.14	0.18	0.21	0.18	0.16
			Case 8			
Mean	1.03	0.99	0.97	0.90	0.89	0.96
STD	0.02	0.07	0.07	0.09	0.08	0.08
			Case 9			
Mean	0.85	0.79	0.77	0.65	0.67	0.75
STD	0.06	0.13	0.15	0.17	0.14	0.14
			Case 10			
Mean	0.60	0.60	0.60	0.59	0.60	0.60
STD	0.01	0.01	0.02	0.03	0.01	0.02
			Case 11			
Mean	0.53	0.53	0.53	0.52	0.53	0.53
STD	0.01	0.01	0.01	0.02	0.01	0.01
			Case 12			
Mean	0.48	0.48	0.48	0.46	0.47	0.48
STD	0.01	0.02	0.02	0.05	0.03	0.03
			Case 13			
Mean	0.47	0.46	0.47	0.45	0.46	0.46
STD	0.01	0.01	0.02	0.03	0.02	0.02

APPENDIX C – ANALYSIS OF WASTEWATER TREATMENT PLANT NUTRIENT LOADS

Date: February 13, 2007

To: Kona Kai Ola Project Team, File

From: Lauren Schmied, Rafael Cañizares

CC: John Headland, Russ Boudreau

Subject: Kona Kai Ola Water Quality Model
Clarification of Assumptions Regarding WWTP
M&N File 5818

A brief analysis was performed to determine the effects on the water quality of the brackish groundwater entering the system after the Marina expansion and the upgrade to the local wastewater treatment plant (WWTP). It is estimated that if the WWTP were to be left in its current state (secondary treatment), the water quality into the new Marina would contain significantly higher nutrient loads than those entering the current Harbor. This is based on the information presented in Waimea Water Services, Inc. (2006). The data presented by AECOS as an appendix in the aforementioned document shows that the nutrient values at Wells 2 and 6 are significantly higher than other wells within the Park (Table C-1). Well 2 has the highest concentrations as this is closest to the point where the wastewater is discharged (DEIS, 2006). Well 6 is shown to be proximal to the location of the new Marina, and thus the values of nutrients entering the new Marina without upgrading the WWTP would be similar to those found at Well 6. This introduces a much higher phosphorous load into the system. In the Hydrodynamic and Water Quality Modeling draft report prepared by Moffatt and Nichol (February 2007), the phosphorous concentration within the new Marina is shown to be one of the significant water quality problems facing the expansion.

Table C-1: Water Quality Conditions as reported by AECOS (2006)

	Well 2	Well 6	Harbor Spring	Quarry Well
Salinity (ppt)	4.4	18.4	25.1	5.3
Nitrate (mg-N/L)	0.54	0.59	0.42	1.20
TP (mg-P/L)	2.71	0.62	3.70	0.07
Ammonia (mg-N/L)	0.005	0.002	0.003	0.003

The DEIS (submitted December 2006) states that the existing WWTP will be upgraded to tertiary treatment and will no longer be discharged into the groundwater. In order to determine the water quality of the brackish water entering the existing Harbor and the new Marina without the effects of the WWTP effluent, the values of the Quarry Well sampling (Table C-1) were assumed to be representative of water without the effects of the WWTP as it is located upstream of the injection site. Values from Quarry Well were diluted with oceanic water (including the nutrient loads of the background ocean conditions) to the salinity of the water entering the existing Harbor (on the order of 22 ppt), resulting in values not significantly different to those already used as input to the water quality model. Table C-2shows the values reported by various

researchers of the brackish water entering the Harbor. It is seen that these values remained fairly constant over the years. Comparing these values to those computed from diluting the Quarry Well data shows that the WWTP effluent effect on the waters entering the existing Harbor is fairly negligible, and therefore the values used in the model represent brackish water with no wastewater effects. This represents the conditions that will occur upon completion of the WWTP upgrade.

If current wastewater effects were to be considered in the model, their effect to the new Marina would be significant as the phosphorous values measured at Well 6 (Table C-1), are much higher than those used within the model. It appears that the new Marina intersects the pathways of the brackish groundwater carrying the WWTP effluent from its actual discharge location, and so without an upgrade to the current system, the simulated water quality conditions would be much worse than the results presented in the Hydrodynamic and Water Quality Modeling draft report prepared by Moffatt and Nichol (February 2007).

Table C-2: Estimate of Water Quality Conditions at the New Marina location without WWTP discharge

	AECOS (2006 Harbor Spring)	Hoover and Gold (2005) (22 ppt)	Johnson *et al.* (2006) (22 ppt)	Bienfang (1980)	Model Inputs	Computed Dilution Values (2006 Quarry Well)
NO_3-N	0.42 mg-N/L	0.336 mg-N/L	0.434 mg-N/L	0.5 mg-N/L	0.42 mg-N/L	0.513 mg-N/L
PO_4-P	-	0.0465 mg-P/L	0.0589 mg-P/L	0.0744 mg-P/L	0.06 mg-N/L	0.052 mg-P/L
NH_4-N	0.003 mg-N/L	0.014 mg-N/L	-	-	0.014 mg-N/L	0.002 mg-N/L

REFERENCES

Bienfang, P. (1980). “Water Quality Characteristics of Honokohau Harbor: A Subtropical Embayment Affected by Groundwater Intrusion.” Pacific Science, vol 34(3). pp. 279-291.

Hoover, Daniel and Gold, Collette, National Park Service, U.S. Department of the Interior (2005). “Assessment of Coastal Water Resources and Watershed Conditions in Kaloko-Honokohau National Historic Park, Hawaii.” Technical Report NPS/NRWRD/NRTR-2005/344.

Johnson, A., C. Glenn, P. Lucey, W. Burnett, R. Peterson, H. Dulaiova, and E. Grossman (2006). “Thermal Infrared surveys and nutrients reveal substantial submarine groundwater discharge systems emanating from the Kona coast of Hawaii.” *Eos Trans. AGU*, *87*(36), Ocean Sci. Meet. Suppl., Abstract OS15B-06.

Waimea Water Services, Inc. assisted by Mink and Yuen, Inc. (2006) "Ground-water Hydrology in the Vicinity of Honokohau Harbor" Draft Report

APPENDIX D – NUTRIENT LOADS FROM MARINE EXHIBITS (CLOWARDH2O)

DESCRIPTION OF CALCULATIONS FROM CLOWARD H2O

Nitrogen – Almost all of the nitrogen introduced into the aquarium is excreted by the fish in the form of ionized and un-ionized ammonia. Due to the rapid flushing of the exhibit tanks, (less than 3 hours for all exhibits) there is insufficient time of any significant metabolism of the ammonia to nitrite/nitrate. Each kg of feed typically produces .03kg of total N. (Timmons and Losordo, 1994)

TSS – Each kg of feed will produce 0.30kg of solids waste (Timmons and Losordo, 1994)

Phosphorous – Fish requirements for phosphorous in their diet is small, though important to proper development, particularly of the skeletal and scale structures. Most metabolic P wastes are excreted as phosphate via the urine. The levels of those P excretions are determined by plasma phosphate concentration within the animals (D. Bureau. 2004). By controlling the dietary intake of phosphorous in the animals, the excretions of phosphorous are minimized and controlled to insignificant levels.

Table D-1: Calculation of nutrients for water features

Feature	Surface Area, Acres	Surface Area, Sq.Ft.	Average Depth, Ft.	Volume, Gallons	Turnover, Minutes	Flow Rate, Gpm	Weighted Average Turnover Time, Minutes	Weighted Average Flow Rate, New Water, GPM	Lbs of Fish, based on 1 lb/100 gallons of water	Kg of Feed at 2% of body weight per day	Kgs of Suspended solids produced per day	Kgs of Ammonia produced per day as mg/l of total nitrogen TAN
Upper Lagoon	4.5	196,020	4	5,864,918	360	16,291	147.4403		0	0	0	0
Dolphin Lagoon	0.75	32,670	6	1,466,230	160	9,164	16.38225		14,662	133.2936	39.98808	3.998808
Dolphin Holding	0.2	8,712	10	651,658	160	4,073	7.281001	4887	6,517	59.2416	17.77248	1.777248
Snorkel Lagoon	0.75	32,670	7	1,710,601	70	24,437	8.361775	48874	17,106	155.5092	46.65276	4.665276
Ray Lagoon/kids touch and	0.4	17,424	3	390,995	120	3,258	3.276451	8146	3,910	35.54496	10.663488	1.066349
Shark Lagoon	0.3	13,068	8	781,989	120	6,517	6.552901	10861	7,820	71.08992	21.326976	2.132698
Turtles and Biters	0.2	8,712	8	521,326	120	4,344	4.368601	6517	5,213	47.39328	14.217984	1.421798
Swim Lagoon	3	130,680	3	2,932,459	360	8,146	73.72014		0	0	0	0
Total	10.1	439,956	49	14,320,176	1,470	51,793	267	53,557	55,228	502.0726	150.62177	15.06218

REFERENCES

Timmons, M. B. and Losordo, T. M. (2006). Aquaculture Water Resuse Systems: Engineering Design and Management. Elsevier Science B. V.

Bureau, D. P. (2004). “Factors Affecting Metabolic Waste Outputs in Fish,” Fish Nutrition Research laboratory, University of Guelph, Guelph, Ontario, Canada.

United States Department of the Interior

NATIONAL PARK SERVICE
Ala Kahakai National Historic Trail
74-4786 Kanalani Street, #14
Kailua-Kona, Hawaii 96740
Tel. (808) 326-6012
Fax. (808) 329-2597

IN REPLY REFER TO:

February 6, 2007

Mr. Scott Condra
Jacoby Development LLC,
171 17th Street, NW Ste 1550
Atlanta, Georgia 30363

RE: Kona Kai Ola DEIS – Ala Kahakai NHT Comments

Thank you for providing this opportunity to comment on the subject DEIS. This is to indicate that after reviewing the document, the Ala Kahakai NHT presently finds it necessary to recommend that the No Action Alternative be chosen for this proposed development. This is being recommended because the DEIS provides only one development alternative and does not adequately address the mission of the Ala Kahakai NHT. General comments on the DEIS are further elaborated on as follows:

Section 4 Assessment of Existing Human Environment
Section 4.1 Cultural Resources
The DEIS does not identify the Ala Kahakai National Historic Trail in the cultural resource section. The mission of the National Historic Trail is to preserve in place ancient and historic trails and routes. Page 63 of the DEIS mentions cartographic evidence of a shoreline trail route coming from Lanihau. Because this trail connected features contained in the cultural landscape, it needs to be incorporated into the planning for the shoreline trail and the DEIS should be revised to reflect this incorporation.

It is recommended that the preservation and management for pedestrian use of ancient and historic trails and routes must be incorporated into the entire development landscaping and pedestrian circulation plan to the highest degree possible. The integrity of mauka-makai trails and lateral shoreline trails should be preserved in place.

It should be noted that the preferred management alternative in the Draft Ala Kahakai NHT Comprehensive Management Plan/EIS, referred to as the "Ahupua'a Trail System," calls for the preservation of a system of trails that includes ancient and historic shoreline and near shoreline routes in order to incorporate features such as what is now referred to as the "Mamalahoa Trail" and mauka-makai trails. The NPS recommends that consideration and discussion be given for all trails and associated archaeological features within the proposed development for incorporation into pedestrian circulation and interpretive pathways to the highest degree possible. In addition, ethnographic information (oral histories, stories, wind names, etc.), visual descriptions (i.e. conceptual maps, dioramas, and elevation drawings) and written interpretations of the cultural landscape as it existed during various phases of ancient and historic times should be developed and incorporated into educational, interpretive facilities and programs to be developed on-site and made available to lineal descendants and schools. This action would be consistent with the intentions stated and overtures presented in public by JDI, but not demonstrated in the DEIS, to preserve the Hawaiian culture.

Section 4.2 Archaeological Resources
Section 4.2.1.2 DLNR and Parkway Corridor Site Findings
DEIS does not mention the Ala Kahakai National Historic Trail or the National Historic Landmark designation that applies to a portion of the project site in this section. It is unclear in this section if human-modified anchialine pools are included in the 432 features. No direct connection appears to be made between the cultural and natural aspects of the anchialine pools.

According to the DEIS, no trails outside of the shoreline setback or buffer are to be preserved. In an area that derives its name from a trail or path, the decision to not preserve trails is inconsistent with previous discussion in this DEIS on ahupua'a values. The DEIS explains: "*The translation of Kealakehe is interpreted in two ways: 1) Kealakehe, with the emphasis on the last syllable, translates as "the pathway of graves"; 2) Kealake'e, with an 'okina replacing the "h," is the more popular definition, which means "winding path.*" (page. 62, par.1)

Page 68 states: "*The most significant (in length) trail segment is 7704 which is 428 feet long marked by 26 aligned cairns. This trail segment is located on the makai boundary of the wastewater treatment plant and extends in a north south direction but appears to be a partially constructed spur of another trail that was abandoned and not utilized.*" Trail 7704 along with the trail identified in the Emerson 1880 Map (Site 50-10-27-21588) should be preserved and would compliment the "Ahupua'a Trail System" as it pertains to the mission of the Ala Kahakai. NHT (see Section 4.1 above). More effort should be placed on locating and preserving Trail 21588 (see comments below on Appendix L), preserving trail 7704, and consultation with Ala Kahakai NHT on preservation and mitigation.

Appendix L: Archeological Inventory Surveys 2006
Ala Kahakai National Historic Trail is not mentioned. Within the northeastern DLNR parcel that abuts Kaloko-Honokohau NHP and the DHHL parcel, a trail identified within the report and referred to as the trail on Emerson's 1880 map (page. 12 par. 4, fig. 5 and page227, par. 5) could not be located during the survey. This trail is well documented within the National Park as site 50-10-27-21588. A portion of the trail has been destroyed with the development of Gentry's Marina boat yard. In 2002, an archeological survey was conducted by Kaloko-Honokohau NHP for a temporary sewer line through the State Highway easement makai of Queen Ka`ahumanu Highway. During the NPS survey, the trail, site 21588, was located along with a well defined

causeway. The trail within the National Park and in the state easement is characterized as a single-file foot/hoof worn trail over pahoehoe. There are no curbstones associated with this trail but it may have petroglyphs and cairns. With the thickness of the fountain grass and koa haole, it is not surprising that the trail could not be easily relocated by the developer; however, this lack of discovery does not mean that the trail is not present. Trail 21588 is an important cultural feature, as the DEIS states in the Cultural Impact Study (Appendix K): "*The need to revive mauka – makai trails was expressed, as well as the need to protect cultural and archaeological sites'*" This trail was an important transportation route to and from Honokohau Settlement and the National Park and falls under the Highways Act of 1892, HRS Chapter 264-1(b). This trail should be located and preserved.

Sincerely,

Aric Arakaki

Aric Arakaki
Superintendent

CC: Department of Hawaiian Home Lands
Department of Land and Natural Resources
State Historic Preservation Office
Advisory Council for Historic Preservation
U.S. Fish and Wildlife Service
NOAA Fisheries
Hawaii Office of Environmental Quality Control
Oceanit

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July 23, 2007

Aric Arakaki, Superintendent
U.S. Department of the Interior
National Park Service
Ala Kahakai National Historic Trail
74-4786 Kanalani St., #14
Kailua-Kona, Hawai'i 96740

Dear Mr. Arakaki:

Subject: Kona Kai Ola Draft Environmental Impact Statement
Response to Your Comments Dated February 6, 2007

Thank you for your comments on the Kona Kai Ola Draft Environmental Impact Statement.

We acknowledge Ala Kahakai's recommendation of the "No Action Alternative" because the DEIS provides only one development alternative and does not adequately address the mission of the Ala Kahakai National Historic Trail (NHT).

We note that several comments have addressed the fact that alternatives other than the No Project Alternative were not addressed in the DEIS Section 2, Alternatives Analysis. As explained in the DEIS, the agreement between JDI and the State of Hawaii established a required scope and scale of the project for which the impact analysis was provided. Several comments have addressed the fact that alternatives other than the No Project Alternative were not addressed in the DEIS Section 2, Alternatives Analysis.

Kona Kai Ola is of the position that alternative actions other than a No Project alternative are not currently feasible without an amendment to the agreement with the State. Agency and public comments in response to the DEIS, as well as additional information generated as a result of inquiry into issues raised by the comments, have been helpful in identifying alternative actions that will serve the State's goal of providing additional marina slips for the Kona area. These alternative actions also serve to reduce or mitigate anticipated effects of the proposed development.

Thus, agencies such as the Land Division of the Department of Land and Natural Resources, the U.S. Department of the Interior Fish and Wildlife Service, the Planning Department of the County of Hawai'i, and the Office of Environmental Quality Control (OEQC), as well as community organizations have commented that a reduced scale marina and related facilities should be considered.

The OEQC has also asked that the alternative of a reduced scale project be evaluated under the assumption that DHHL may determine that a downsized project would be preferred.

In response to these comments on the DEIS and in consideration of measures to mitigate anticipated impacts, the EIS Section 2, Alternatives Analysis, has been revised to describe the following alternatives, which are discussed in more detail in the EIS:

- Alternative 1 is a project involving a 400-slip marina, 400 hotel units, 1,100 time-share units, and commercial and support facilities. This alternative would enhance water quality and avoid the need to widen the existing harbor entrance channel, as well as reduce traffic and socioeconomic impacts.
- Alternative 2 is an alternative that had been previously discussed, but not included in the proposed project that includes an 800-slip harbor and a golf course.
- Alternative 3 is the no-action alternative.

A comparison between impacts related to the proposed project concept and impacts related to Alternative 1 indicates that a reduction in the acreage and number of slips in the marina, as well as the reduction in hotel and time-share units, would generate less environmental, traffic, social and economic impacts. Although positive economic impacts would be reduced, Alternative 1 can be considered as a preferable alternative because of reduced environmental impacts. However, while it can be concluded that the 25-acre marina in Alternative 1 would be the preferred size, the DLNR agreement establishes the size of the marina at 45 acres and 800 slips. An amendment to the DLNR agreement is required in order to allow Alternative 1 to proceed. Hence, selection of Alternative 1 is an unresolved issue at this time.

The additional EIS text that includes the added EIS Section 2, Alternative Analysis, is contained in Attachment 1 of this letter.

Section 4: Assessment of Existing Human Environment
Section 4.1: Cultural Resources

While the DEIS and the Archaeological Impact Studies, as contained in EIS Appendices M-1 and M-2, did not specifically mention the Ala Kahakai National Historic Trail (NHT), the project developer fully intends that Kona Kai Ola support the development of the Ala Kahakai NHT as it relates to the proposed onsite trail system. To support the Ala Kahakai NHT system that is currently being developed, the project will connect pedestrian trails that connect to the project site from neighboring lands as a way to help create a trail system that could be part of the system, as well as to implement a bike path, trail system and sidewalk system to encourage these activities.

The Archaeology Impact Study does not specifically mention the Ala Kahakai NHT, but does mention the landmark. As discussed in Section 4.2.1.2, the archeological survey detected no evidence of historic trails that may be included in Ala Kahakai NHT system, although this is not unexpected, given the stretches of sand and bare pahoehoe lava that are easily traversed on foot and marked by shoreline.

The EIS has been revised to acknowledge and support the Ala Kahakai NHT in Sections 4.1.2.1, as follows:

> "The need to revive mauka – makai trails was expressed, as well as the need to protect cultural and archaeological sites. The Ala Kahakai National Historic Trail is a system that is currently being developed to include any historic coastal trail, or connecting mauka and makai trails, along with the addition of new trails to connect these historic trails. The mission of the National Historic Trail is to preserve in place ancient and historic trails and routes. While most of the remnant trails are partial segments of a possible historic network, there are no intact substantial segments. The project seeks to add new trails to connect any remnants from historic trails to provide a coastal trail system along the shoreline park and around the marina basins. This trail system is consistent with the goals and objectives of the Ala Kahakai National Historic Trail, and would be appropriate to be included in that system. The project will seek to improve public access, preserve and where appropriate, enhance cultural and historical features in the area."

We agree with your comment regarding incorporating trails and associated archaeological features into proposed pedestrian circulation and interpretive pathways. Further, the proposed Hawaiian cultural center will feature ethnographic information, visual descriptions, and written interpretations of the cultural landscape.

Section 4.2: Archaeological Resources
Section 4.2.1.1: DLNR and Parkway Corridor Site Findings

Comment: It is unclear in this section if human-modified anchialine pools are included in the 432 features.

> Response: The Archaeology Impact Study documents seven architectural features at Sites 1898 and 1899 that modify natural pools. However, the pools are not assigned feature designations. While it is likely that all were used, if there is no physical evidence of use, then a site/feature designation was not assigned.

Comment: The decision not to preserve trails outside of shoreline setback or buffer is inconsistent with previous DEIS discussion of ahupua'a values.

> Response: The Archaeology Impact Study does not recommend preservation of trails that were solely assessed as significant under

Criterion D (research value). This applies to all trail segments identified. SHPD review did not dispute the assessments, but did request consultation with Na Ala Hele and cultural descendants to identify any concerns about trails. The archaeology consultant briefed Irving Kawashima of Na Ala Hele in Hilo on November 11, 2006 and asked him if Na Ala Hele had any concerns regarding the trails found during the survey. Kawashima has not responded as of this writing; he indicated that a response may take up to one year. The archaeology consultant also contacted Mahaelani Pai, a project cultural consultant and ahupua'a descendant; he did not describe any trails.

Aside from the Emerson map trail (Site 21588) and Site 7704, both of which are discussed later in this letter, four probable prehistoric trails are as follows.

(1) Sites 25572 and 25574, are two trail segments that extend diagonally across the southwestern corner of the project area. The segments are oriented in the same direction with an 82.0 m wide gap between them. If they are part of the same trail it would have an overall length of c. 265 m. The orientation of the trail is not typical of a mauka-makai, or shoreline paralleling main trails.

(2) Sites 25602 and 25607, situated in the north-central portion of the area, also have similar orientations, with a 95.0 m wide gap separating them. Overall length of c. 384 m oriented in a mauka-makai direction. This trail might be a remnant of a mauka-makai trail, but it is truncated by the massive spoil pile from the harbor construction (same is true of Site 7704).

(3) Site 25563 is a short trail segment also truncated by the spoil pile. Orientation is diagonal to the coast suggesting it is not a "main trail".

(4) Site 25549 is a short (66 m) long segment of trail crossing the a'a lava in the northeastern corner of the project area. It is a linear area where larger stones have been moved or displaced resulting in a linear path of smaller stones. The trail is probably an isolated segment because it could not be followed across the rest of the flow.

Trails (1)-(3) lack any construction or evidence of abrasion of the lava surface. All are marked by cairns and/or pieces of coral at irregular intervals. These markers are the only evidence of the trails. Most are probably secondary or tertiary trails used to access specific residential or resource sites as opposed to being main thoroughfares. The main mauka-makai trail(s) in the vicinity probably originated at the bays and fishponds at the coast in Kaloko-Honokohau.

Comment: Trail 7704 trail along with the trail identified in the Emerson 1880 map (Site 50-10-27-21588) should be preserved and would complement the Ahupua'a Trail System.

Response: The first site is discussed in the Archeology Impact Study on page 14 and depicted in Figure 5. The Archaeology Impact Study (p. 227) does not recommend preservation of 7704 trail because "The Site 7704 is an historic 19th Century trail. The absence of abrasions on the lava associated with this very straight trail led Soehren to conclude that it represented a 'preliminary route selection' for a nineteenth century horse trail that was subsequently abandoned, perhaps in favor of the 'Old Mamalahoa Trail, farther inland (Sorhren1980:2)." In other words, the 7704 "trail' is comparable to a series of lathe stakes marking one or more alternate routes for a proposed road. One could also argue that the site's integrity was been significantly diminished by its truncation by the massive spoil pile from harbor construction.

Regarding the trail identified on the Emerson 1880 map (page 227 of the Archaeological Impact Study), "One trail identified by thorough background research could not be relocated. The 1880s Emerson map (see *Figure 5*) shows a road or trail extending from the south toward Kailua to the coast at Honokohau. The trail appears to pass through the portion of project area situated north of the harbor access road, but no evidence of it was identified during the survey. It is possible that there is simply no physical evidence of the trail because this area consists of nearly level pahoehoe lava."

Consultation with the Ala Kahahai NHT on preservation and mitigation will occur as the project progresses.

Appendix L: Archaeological Inventory Surveys 2006

Comment: The Ala Kahakai National Historic Trail is not mentioned.

Response: Please see our response related to Section 4.1

Comment: During the NPS survey, the trail, site 21588, was located along with a well-defined causeway. The trail within the National Park and in the state easement is characterized a single-file foot/hoof worn trail over pahoehoe. There are no curbstones associated with this trail but it may have petroglyphs and cairns. With the thickness of the fountain grass and koa haole, it is not surprising that the trail could not be easily relocated by the developer; however, this lack of discovery does not mean the trail is not present. Trail 21588 is an important cultural feature, as the DEIS states in the Cultural Impact Study."

Response: The area was surveyed three times during the fieldwork with archaeological surveyors walking at 3-5 m intervals. The same area was surveyed during preliminary studies for the project in 2004 also with negative results. Surveyors, including consultant Alan Haun, were specifically looking for worn surfaces, petroglyphs, and cairns. At the time the vegetation was not that thick. Areas of bare pahoehoe lava were clearly visible and all were checked.

Your comment letter and this response are included in the Final Environmental Impact Statement. We appreciate your participation in the environmental review process. Please submit a request to our office if you would like to receive a printed or electronic copy of the Final Environmental Impact Statement, or portions thereof.

Sincerely,

Dayan Vithanage, P.E., PhD.
Director of Engineering

cc: Office of Environmental Quality Control
State Department of Hawaiian Home Lands
Jacoby Development, Inc.

Attachment 1

2 Alternatives Analysis

~~In typical land development projects, the initial planning process includes the exploration of alternatives to development objectives. In the EIS process, these alternatives are presented with a disclosure of reasons for the dismissal of non-preferred alternatives.~~

~~Kona Kai Ola does not follow this same pattern of alternatives evaluation.~~ As discussed in Section 1.4, the proposed Kona Kai Ola project is the result of agreements between JDI and the State DLNR and DHHL. The agreements and leases between the State and JDI stipulate the parameters of development for this site in terms of uses, quantities and size of many features, resulting in a limited range of land uses. Unlike a private property project, JDI is required to meet the criteria outlined in the agreements, thereby affording less flexibility in options and uses. From the developer's perspective, the agreements must also provide sufficient flexibility to allow for a development product that responds to market needs and provides a reasonable rate of return on the private investment.

The agreements between JDI and DLNR specify that the proposed harbor basin is to be 45 acres and accommodate 800 slips. This development proposal is the subject of this EIS. In response to DEIS comments, additional water quality studies and modeling were conducted. These studies determined that the water circulation in a 45-acre 800-slip marina would be insufficient to maintain the required standard of water quality. The models of water circulation suggest that a new 25-acre harbor basin could successfully maintain required water quality in the new harbor. Comments on the DEIS from DLNR, from other government agencies, the neighbors and the general community also called for the consideration of alternatives in the EIS, including a project with a smaller harbor basin and less density of hotel and time-share units.

In response to these comments on the DEIS, three alternatives are evaluated in this Final EIS and include Alternative 1, which is a plan with a 25-acre 400-slip harbor basin including a decrease in hotel and time-share units; Alternative 2, which is an alternative that had been previously discussed but not included in the proposed project, that includes an 800-slip harbor and a golf course; and Alternative 3, the no-project alternative. Each alternative is included in the EIS with an evaluation of their potential impacts. These project alternatives are presented to compare the levels of impacts and mitigation measures of the proposed project and alternative development schemes pursuant to requirements set forth in Chapter 343, HRS.

~~JDI is required to provide a new marina basin not less than 45 acres and a minimum of 800 new boat slips. Further, the agreements provide the following options for land uses at the project site:~~

- ~~Golf Course~~
- ~~Retail Commercial Facilities~~
- ~~Hotel Development Parcels~~
- ~~Marina Development Parcels~~
- ~~Community Benefit Development Parcels~~

~~JDI is not pursuing the golf course option and is proposing instead to create various water features throughout the project site. All other optional uses have been incorporated in Kona Kai Ola.~~

2.1 Project Alternatives

2.1.1 Alternative 1: 400-Slip Marina

Studies conducted in response to DEIS comments found the construction and operation of an 800-slip marina may significantly impact the water quality within the marina and along the shoreline. Specifically, the Harbor Water Quality Modeling Study, as contained in Appendix U, found that the water circulation in a 45-acre 800-slip harbor was insufficient to maintain an acceptable level of water quality. Further, the existing harbor channel, which would serve both the existing and new harbors, could not adequately serve the increased boat traffic generated by an 800-slip marina during peak traffic. Mitigation measures to accommodate peak boat traffic included the widening of the existing channel, an action that would entail a complex process of Federal and State approvals and encounter significant environmental concern.

Concerns related to the proposed density of hotel and time-share units were also expressed in comments to the DEIS from members of the public, neighbors to the project site, especially the Kaniohale Community Association, and government agencies. Common themes in DEIS comments were related to impacts regarding traffic, project requirements of potable water and infrastructure systems, including sewer, drainage, utility and solid waste systems, and socioeconomic impacts.

In response to the water quality study results, and to the DEIS comments, an alternative plan was developed with a smaller marina with less boat slips, and a related decrease in hotel and time share units. Illustrated in Figure G, Alternative 1 reflects this lesser density project, and features a 400-slip marina encompassing 25 acres. For the purposes of the Alternative 1 analysis, JDI assumed 1,100 time-share units and 400 hotel rooms. Project components include:

- 400 hotel units on 34 acres
- 1,100 time-share units on 106 acres
- 143 acres of commercial uses
- 11 acres of marina support facilities
- 214 acres of parks, roads, open spaces, swim lagoons and community use areas

In addition, Alternative 1 would include the construction of a new intersection of Kealakehe Parkway with Queen Ka‘ahumanu Highway, and the extension of Kealakehe Parkway to join Kuakini Highway to cross the lands of Queen Lili‘uokalani Trust, and connecting with Kuakini Highway in Kailua-Kona. This is a significant off-site infrastructure improvement and is included in the agreements between the State and JDI.

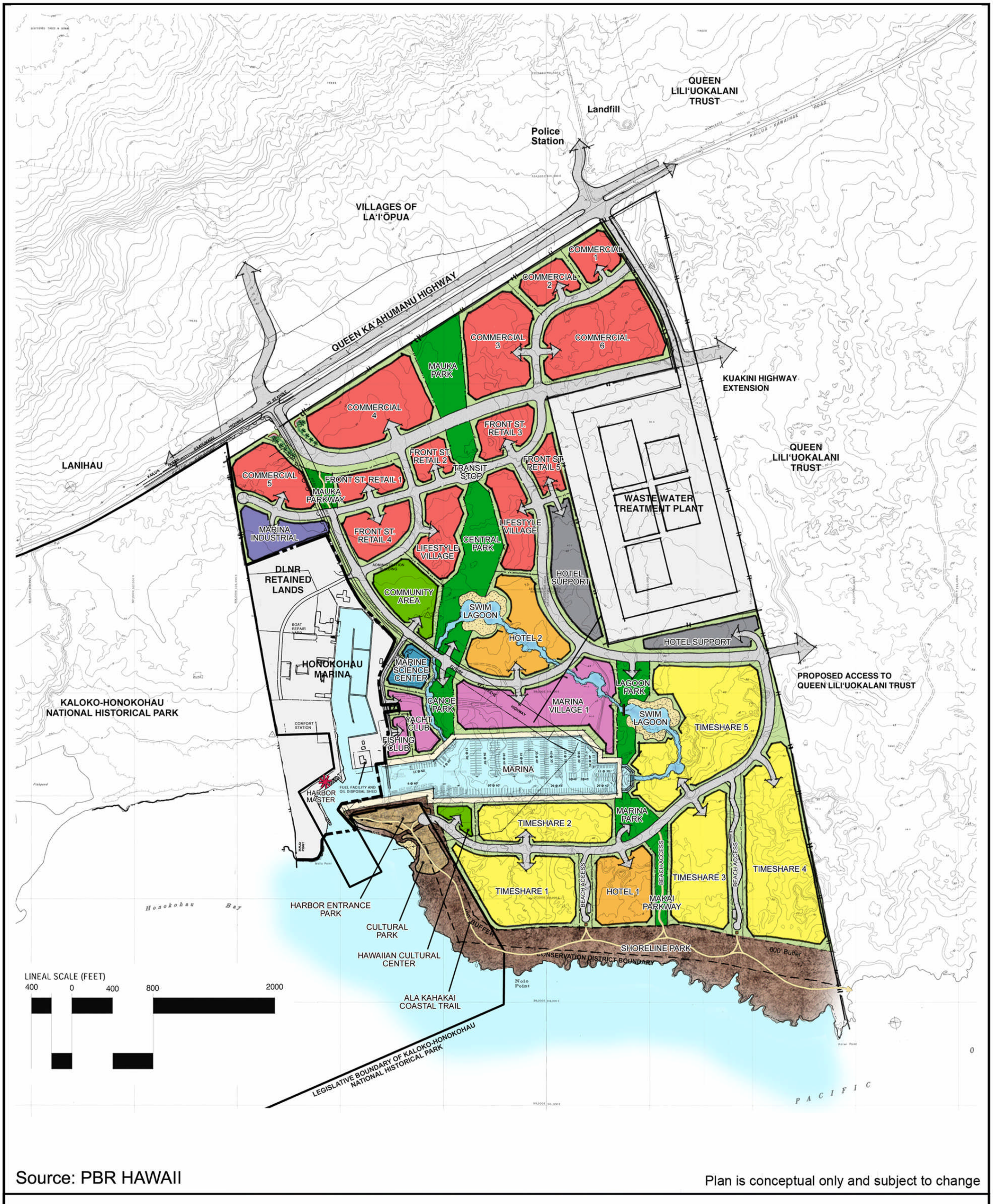

Figure G: Alternative 1: 400-Slip Marina

LEGEND

- TIME SHARE
- HOTEL
- RETAIL / COMMERCIAL
- MARINA RETAIL
- MARINA SUPPORT / COMMERCIAL
- MARINE SCIENCE CENTER
- COMMUNITY AREA / CULTURAL CENTER
- SWIM LAGOON
- MARINA
- UTILITIES
- PARKS & GREEN SPACE
- SHORELINE
- HARBOR ENTRANCE PARK / CULTURAL PARK

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JDI
JACOBY DEVELOPMENT, INC.

Like the proposed project, Alternative 1 would have a strong ocean orientation, and project components that support this theme would include various water features including seawater lagoons and a marine science center. The new Alternative 1 harbor would include a yacht club, fishing club, a canoe park, and a cultural park with a focus on Hawaiian maritime cultural heritage of the voyaging canoe. The coastal area would be protected with a shoreline park with trails and public access parking for walking and shoreline fishing, and a cultural park surrounding the heiau, the cultural sites and 'Alula for community use. Additional Alternative 1 community areas would include facilities and space for community use, including programs of the Kona Kai Ola Community Foundation, which supports community programs in health care, culture, education, and employment training for the local community, especially to native Hawaiians. Like the original proposed plan, Alternative 1 includes 40 percent of the land in parks, roads, open spaces, swim lagoons and community use areas.

2.1.2 Alternative 2: Golf Course Feature

Alternative 2 was among the alternatives discussed at a community charrette in September 2003. It includes a golf course, which is a permitted use in the DLNR agreement and DHHL lease. As Figure H illustrates, an 18-hole championship golf course would occupy 222 acres on the southern portion of the project site. As with the proposed project, Alternative 2 includes an 800-slip marina on a minimum of 45 acres.

To support the economic viability of the project, other Alternative 2 uses include:

- Golf course clubhouse on three acres
- 1,570 visitor units on 88 acres fronting the marina
- 118 acres of commercial uses
- 23 acres of community uses

Community uses in Alternative 2 include an amphitheater, a canoe facilities park, a community health center, a Hawaiian cultural center and fishing village, a marine science center and employment training center. The sea water lagoon features contained in the proposed project and Alternative 1 are not included in this alternative.

2.1.3 Alternative 3: No Action

In Alternative 3, the project site would be left vacant, and the proposed marina, hotel and time-share facilities, commercial and marina industrial complexes, and community-oriented uses would not be realized.

~~The economic viability and sustainability of the project is determined by the density and uses proposed. Because JDI is obligated to develop an 800-slip marina for the State, complete road improvements, and provide various public enhancement features at its own expense, the density proposed for the income generating features of the development must be sufficient to provide an acceptable level of economic return for JDI. The market study, which is discussed in Section 4.6, reviewed various development schemes and determined that the currently proposed density and mix is the optimum to meet the anticipated financing and development cost obligations for the public features associated with the development.~~

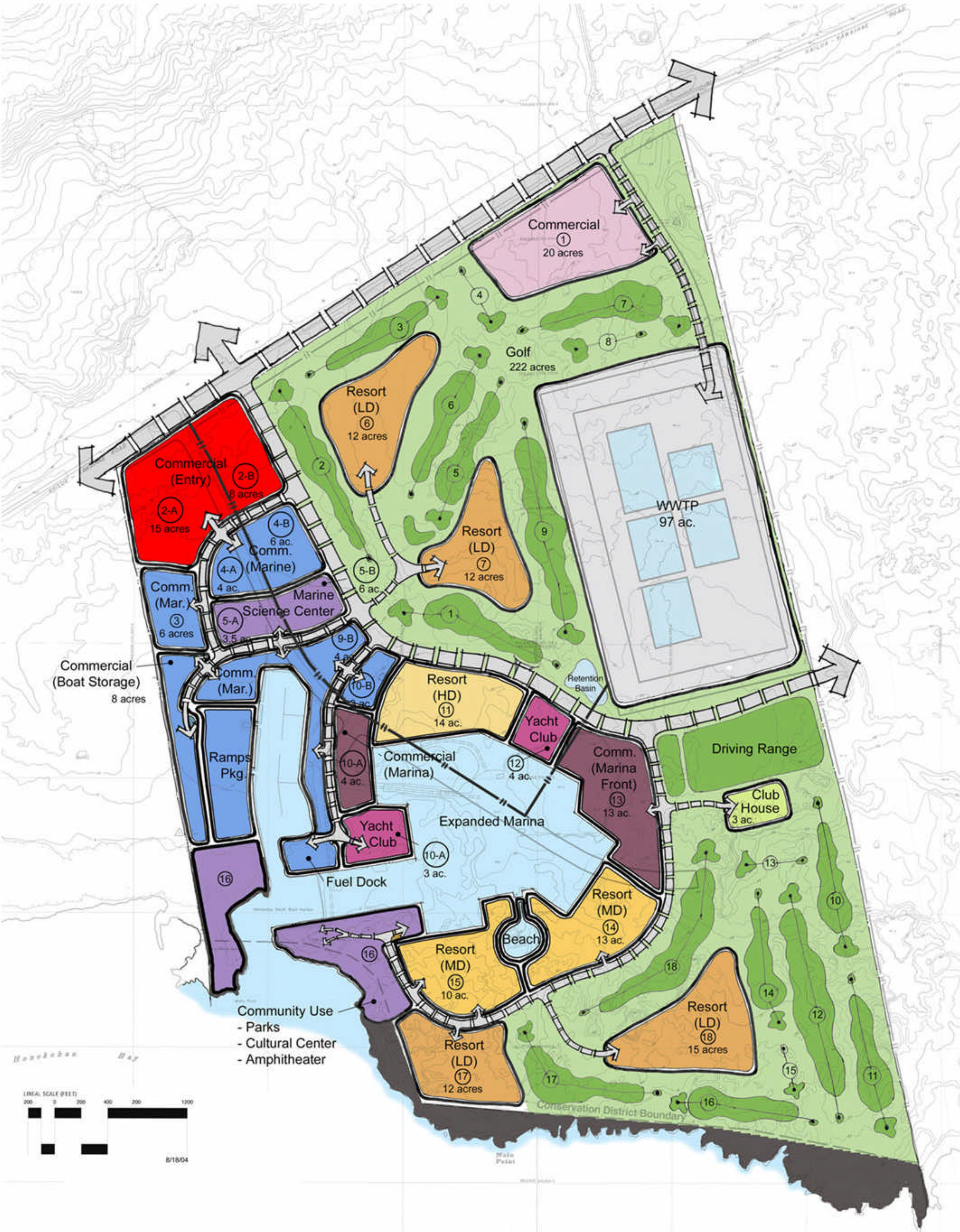

Figure H. Alternative 2: Golf Course Alternative

Legend

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JACOBY DEVELOPMENT, INC.

2.2 Alternatives Analysis

As discussed in Section 2.1, the proposed Kona Kai Ola project (also referred to as “proposed project”) is defined by development requirements related for a marina and the related uses that would be needed to generate a reasonable rate of return that covers development costs.

Beginning with Section 2.2.1, the alternative development concepts are comparatively assessed for potential impacts that may reasonably be expected to result from each alternative. Following is an overview of the primary observations of such assessment.

Alternative 1 includes half of the State-required boat slips and 60 percent of the proposed hotel and time-share units and, due to the decreased density, this alternative would generate significantly less environmental and socio-economic impacts. A harbor water quality model found the reduction of the volume of the new marina basin by about half (approximately 25 acres) significantly improved the water circulation and quality. Further, the reduced number of boat slips would generate less boat traffic, thereby reducing congestion and the need to mitigate impacts further by the widening of the existing harbor channel.

A project with fewer hotel and time-share units and increased commercial space with a longer (14 years) absorption period would change the mix of employment offered by the project, and slightly increase the overall employment count. The public costs/benefits associated with Alternative 1 would change, compared to the proposed project, with a general increase in tax collections, and a general decrease in per capita costs. Detailed discussion of Alternative 1 potential economic impacts are provided in Section 4.6.6. Comparisons of levels of impact are presented throughout this FEIS.

While this analysis might indicate that the 25-acre marina in Alternative 1 would be the more prudent choice, the DLNR agreement establishes the minimum size and slip capacity of the marina at 45 acres and 800 slips, respectively. Amendments to the DLNR agreement would be required in order to allow Alternative 1 to proceed as the preferred alternative. Hence, selection of the preferred alternative is an unresolved issue at the writing of this FEIS.

Alternative 2, the golf course alternative, was not previously considered to be the preferred alternative primarily because market conditions at the time of project development might not likely support another golf course. Further, DHHL has a strategy goal to have more revenue-generating activities on the commercial lease lands within the project area. In addition, concerns have been expressed as to environmental impacts of coastal golf courses, including the potential adverse impact on Kona’s water supply if potable water is used for golf course irrigation.

While Alternative 3, the no-project alternative, would not generate adverse impacts related to development of these lands associated with the construction and long-term operations, it would also not allow for an expanded public marina that would meet public need and generate income for the public sector. Further, the no-project alternative would foreclose the opportunity to create a master-planned State-initiated development that would result in increased tax revenue, recreation options and community facilities. Crucial privately-funded improvements, such as the marina, regional roadway and circulation improvements, and improvements to the existing wastewater treatment plant, would not be implemented. Private funds toward the development of community-oriented facilities such as parks, other recreational facilities, and public access would not be contributed.

~~Hence, the only valid alternative to the proposed project is the no-action alternative. In this alternative, the project site would be left vacant, and the proposed marina, hotel and time-share facilities, commercial and marina industrial complexes, and community-oriented uses would not be realized.~~

~~The no-project alternative would therefore not generate adverse impacts associated with the construction and long-term operations would not occur.~~

~~Likewise, the creation of a master-planned state-initiated development, resulting in increased employment, tax revenue, recreation options and community facilities, would not be created. Privately-funded improvements, such as the marina, regional roadway and circulation improvements, and improvements to the existing wastewater treatment plant, would not be implemented. Private funds toward the development of community-oriented facilities such as parks, other recreational facilities and public access would not be contributed.~~

Further, the creation of revenue-producing businesses on the DHHL property to fund homestead programs would not occur, resulting in fewer potential benefits for Hawaiians.

Hence, the agreements and leases between the State and JDI indicate that the no-action alternative is not in the public interest~~has been rejected at this time~~.

2.2.1 Impact Comparison

Grading and Excavation

The proposed project requires grading and excavation. Both actions may impact groundwater due to rainfall runoff during construction. Alternative 1 would require a significantly smaller excavation for the marina basin and would therefore carry a lesser risk of potential adverse effects on water quality. Alternative 2 would require the same basin excavation as the proposed project, and would also include extensive grading and filling to build the golf course, the latter of which would generate additional impacts. Alternative 3 would result in no change to the geography, topography and geology.

Further discussion on grading and excavation is contained in Section 3.3.

Natural Drainage

Most precipitation infiltrates into the porous ground at the site, and no significant sheet flow is likely. Alternative 1 would generate similar levels of impacts on natural drainage as those of the proposed project and thus require similar mitigation measures. The golf course in Alternative 2 would not be as porous since the site would be graded, soil would be placed, and grass and other landscaping would be grown. Sheet flow and runoff can occur on a golf course, and drainage patterns might change. Alternative 3 would result in no change to the existing natural drainage pattern. Further discussion on natural drainage is contained in Section 3.4.

Air Quality

Air quality will be affected by construction activities, as well as pollutants from vehicular, industrial, natural, and agricultural sources. Alternative 1 would generate less construction air quality impacts than the proposed project due to the reduced amount of intensive groundwork associated with the smaller marina basin and fewer long-term impacts by reducing traffic 35 and 40 percent during, respectively, AM and PM peak traffic times. Construction of Alternative 2 would result in fugitive dust and exhaust from equipment and is expected to generate the same level of air quality impact as the proposed project. Alternative 3 would result in no change to existing air quality. Further discussion on air quality is contained in Section 3.5.

Terrestrial Environment

To provide additional habitat for shorebirds and some visiting seabirds, the project proposes to construct a brackishwater pond area suitable for avian fauna, including stilts, coots and ducks. While habitat expansion is beneficial, there is also a possibility that these species may be exposed to activity that may harm them. Alternative 1 would not include a brackish water pond, but will include 5 acres of seawater features, which is 74 percent less than the 19 acres of seawater features in the proposed project. While this would reduce beneficial impacts, it would also decrease exposure to potentially harmful activity. Alternative 2 does not include the brackish water pond features, but would include drainage retention basins that would attract avian fauna and expose them to chemicals used to maintain golf course landscaping. While Alternative 3 would result in no increase in potentially harmful activity, it would also not provide additional habitat for avian fauna. Further discussion on the terrestrial environment is contained in Section 3.7.

Groundwater

Groundwater at the project site occurs as a thin basal brackish water lens. It is influenced by tides and varies in flow direction and salt content. The existing Honokōhau Harbor acts as a drainage point for local groundwater. Any impact to groundwater flow from the proposed harbor is likely to be localized. The proposed marina basin will not result in any significant increase in groundwater flow to the coastline, but rather a concentration and redirection of the existing flows to the harbor entrance.

There will be differences in the flow to the marina entrance between the proposed project and Alternative 1. Alternative 1, being smaller in size, will have less impact on groundwater flow than the proposed marina. Alternative 2 will have a similar impact to groundwater quality as the proposed project. Alternative 2 may also impact water quality by contributing nutrients and biocides to the groundwater from the golf course. Alternative 3 would result in no change in existing groundwater conditions. Further discussion on groundwater is contained in Section 3.8.1.

Surface Water

There are no significant natural freshwater streams or ponds at the site, but there are brackish anchialine pools. Surface water at the project site will be influenced by rainfall. Runoff typically percolates rapidly through the permeable ground. The proposed project will include some impermeable surfaces, which together with building roofs, will change runoff and seepage patterns.

Alternative 1 is a lower density project that is expected to have proportionally less impact on surface water and runoff patterns and less potential impact on water quality than the proposed project. Alternative 2 would have more impact on surface water quality than the proposed project due to fertilizers and biocides carried by runoff from the golf course. Alternative 3 would result in no change to surface water conditions. Further discussion on surface water is contained in Section 3.8.2.

Nearshore Environment and Coastal Waters

The potential adverse impacts to the marine environment from the proposed project are due to the construction of an 800-slip marina and the resulting inflow of higher salinity seawater and inadequate water circulation, both of which are anticipated to impair water quality to the extent of falling below applicable standards. One possible mitigation measure is to significantly reduce the size of the marina expansion.

The reduced marina size (from 45 to 25 acres) and reduced lagoon acreage in Alternative 1 are expected to result in a proportionate reduction in seawater discharging into the new harbor and increased water circulation. Alternative 2 includes the same marina basin size and is therefore subject to the same factors that are expected to adversely affect water quality.

In the existing Honokōhau Harbor, water quality issues focus on the potential for pollutants, sediments, mixing and discharge into the nearshore marine waters. Before the harbor was constructed, any pollutants entrained within the groundwater were believed to have been diffused over a broad coastline.

The water quality in the proposed harbor depends on several components. These include salinity, nutrients, and sediments that come from the ocean, rainfall runoff, water features with marine animals, and dust. The smaller project offered as Alternative 1 is expected to produce a reduced amount of pollutants and reduce the risk of adverse impact upon water quality.

It is notable that the 45-acre marina basin planned in the proposed project and Alternative 2 only becomes viable from a water quality impact standpoint if the additional brackish groundwater inflow into the new marina exceeds 60 mgd. The resulting flushing from such inflow would be expected to better maintain water quality. However, it is unclear whether 60 mgd of brackish groundwater would be available. As proposed in Alternative 1, reduction of the volume of the new marina basin by 45 percent will significantly improve the flushing and water quality because the lower volume can be flushed by the available groundwater flow.

In addition, there could be higher rainfall runoff from the Alternative 2 golf course into the harbor, because the grassed golf course will be less porous than the natural surface. The golf course will also require relatively high levels of fertilizer, biocides, and irrigation, all of which could contribute to adverse water quality impacts.

Further discussion on nearshore environment and coastal waters is contained in Section 3.9.1.

Anchialine Pools

Anchialine pools are located north of Honokōhau Harbor, and south of the harbor on the project site. The marine life in these pools is sensitive to groundwater quality, and changes due to construction and operation of the project could degrade the viability of the pool ecosystem. In the southern complex, 3 anchialine pools with a combined surface area of $20m^2$ would be eliminated due to the harbor construction in the proposed project and Alternatives 1 and 2.

Predicting the extent of change in groundwater flow is difficult if not impossible even with numerous boreholes and intense sampling. The actual flow of groundwater towards the sea is minimal today, and tidal measurements show that tide fluctuations represent more than 90 percent in actual harbor tides. The fluctuations occur simultaneous with the ocean/harbor tide, which indicate a vertical and horizontal pressure regime between bore hole 6 and the ocean and harbor. Hence, the tides alone create a mixing system that increases salinity, as the flow approaches the point of discharge which will be either the channel or the shore. Another factor that could influence groundwater quality is the increased local recharge from irrigation between the channel and shore. This will add fresh water to the lens locally but is not quantified at this time.

Quantification of these impacts, including the flow of groundwater through each pond, is therefore extremely difficult. The shallow lavas are of the pahoehoe type and have a relatively high horizontal permeability. In surface depressions or undulations, the pahoehoe lavas have a tendency to lose vertical permeability from sedimentation thus restricting water exchange within the individual pools. This is normally reflected in both the salinity and temperature and this information has been adequately studied in the pools.

Changes in groundwater quality may or may not impact biological communities in the anchialine and estuarine environment. In either case, it is important to understand these relationships to effectively manage the resource. If there is significant deviation from the baseline especially in regard to nutrients, pathogens, and toxins, a mitigation plan to determine the cause and take decisive appropriate action will be implemented.

Due to the uncertainty of changes in groundwater flow and quality due to marina construction, the variability in impacts between the proposed project and Alternatives 1 and 2 is unknown at this time. Alternative 3 would result in no change in groundwater flow. While this would eliminate the potential for adverse impacts, Alternative 3 would also continue the pattern of existing degradation related to human activity and the introduction of alien species. Further discussion on anchialine pools is contained in Section 3.9.2.

Marine Fishing Impacts

The proposed marina will increase the number of boats in the area and it is reasonable to assume that a portion of these new boats will engage in fishing activities. The increase in boats in the area would be primarily related to the marlin and tuna / pelagic fishery, coral reefs due to extractive fisheries, and SCUBA activities. The pressure on fish and invertebrate stocks is expected to increase with or without the marina. Harbor expansion provides the opportunity to address existing conditions to consolidate, focus, and fund management and enforcement activities at one location.

Compared to the proposed project, Alternative 1 would result in a 21 percent decrease in boat traffic, thereby lessening the potential for marine fishing impacts. The level of impacts in Alternative 2 would be similar to that of the proposed project. Alternative 3 would result in no change in existing marine fishing conditions, and no opportunity to address already existing pressure on fish and invertebrate stocks. Further discussion on marine fishing impacts is contained in Section 3.9.3.

Cultural and Archaeological Resources

The proposed project will integrate cultural and archaeological resources in the overall development. Archaeological sites recommended for preservation will be preserved, and cultural practices will be encouraged. Kona Kai Ola includes a canoe park, and a cultural park with a focus on Hawaiian maritime cultural heritage of the voyaging canoe. Proposed is a 400-foot shoreline setback that would serve as a buffer between the ocean and developed areas. This coastal area would be protected with a shoreline park with trails and public access parking for walking and shoreline fishing, and a cultural park surrounding the heiau, the cultural sites and 'Alula for community use.

Alternative 1 would contain all of the cultural archaeological features and the shoreline setback area would be 400 feet in the northern portion of the site and increase to 600 feet in the southern portion. Alternative 2 would preserve cultural and archaeological resources, but does not include a 400-foot shoreline setback. Alternative 3 would result in no change to existing cultural and archaeological resources and no addition of cultural and community facilities and activities. Further discussion on cultural and archaeological resources is contained in, respectively, Sections 4.1 and 4.2.

Noise

Project-generated noise is due to construction equipment and blasting, boats, marina activities, vehicle traffic, and the Kealakehe Wastewater Treatment Plant operations. Alternative 1 would generate less noise impacts due to reduced construction activities, fewer boats, less traffic and less on-site activity. Alternative 2 would also generate less noise due to reduced traffic and less on-site activity, but noise related to the excavation of the marina basin and an increase in the number of boats would be similar to that of the proposed project. Further discussion on noise impacts is presented in Section 4.4.

Socioeconomic Impacts

The proposed project will generate an increase in de facto population of an estimated 5,321 persons due to the increase in hotel and time-share units. The estimated de facto population increase in Alternative 1 is 37 percent less, at 3,363 persons, than the proposed project. The de facto population increase in Alternative 2 is similar to Alternative 1.

Employment in the commercial components will nearly double in Alternative 1, from a stabilized level of 1,429 full-time equivalent (FTE) positions in the proposed project to 2,740 in the Alternative 1.

Under Alternative 1, the total operating economic activity at Kona Kai Ola will increase due to the added commercial space more than off-setting the fewer visitor units, moving upward from $557.6 million per year to circa $814.3 million annually. The total base economic impact resulting from development and operation of Alternative 1 will similarly be higher by between 35 and 45 percent than that of the proposed project.

Alternative 1, which has a reduced marina size of 25 acres, and fewer hotel and time-share units, would have a meaningful market standing, create significant economic opportunities, and provide a net benefit to State and County revenues. From a market perspective, a smaller Kona Kai Ola would still be the only mixed use community in the Keahole to Kailua-Kona Corridor offering competitive hotel and time-share product.

The estimated absorption periods for marketable components of Alternative 1 are generally shorter than those for the same components in the proposed project. Marina slips under Alternative 1 are estimated to be absorbed within 2 years after groundbreaking, as compared with 9 years for absorption of slips in the proposed project. Hotel rooms under Alternative 1 are estimated to be absorbed within 4 years after groundbreaking, as compared with 7 years under the proposed project. Time-share units would be absorbed within 10 years under Alternative 1, while 15 years are projected under the proposed project. Due to the planned increase in commercial facilities under Alternative 1, the absorption period of commercial space is estimated at 14 years, as compared with 8 years for absorption of such facilities under the proposed project.

The State and County will still both receive a net benefit (tax receipts relative to public expenditures) annually on a stabilized basis under the Alternative 1. The County net benefits will be some $12.2 million per year under the Alternative 1 versus $14.9 million under the proposed project. The State net benefits will increase under the Alternative 1 to about $37.5 million annually, up substantially from the $11.4 million in the proposed project.

Due to the lower de facto population at build-out, the effective stabilized public costs for both the State and County will decline meaningfully under the Alternative 1, dropping from $7.7 million annually for the County and $36.5 million for the State, to $4.9 million and $23 million per year, respectively.

Alternative 3 would result in no increase in de facto population and improvement to economic conditions. Further discussion on social and economic impacts are contained in, respectively, Sections 4.5 and 4.6.

Vehicular Traffic

The proposed project will impact the nearby road network that currently is congested during peak traffic times. The proposed project includes roadway improvements that would reduce the impact and improve roadway conditions for the regional community.

Alternative 1 includes the same roadway system improvements as the proposed project, yet would reduce vehicular traffic by 35 percent when compared to the proposed project. Alternative 2 would have similar traffic conditions and roadway improvements as Alternative 1. Alternative 3 would result in no increase in traffic and no roadway improvements.

Marina Traffic Study

The increase in boat traffic due to the proposed 800-slip marina would cause entrance channel congestion during varying combinations of existing and new marina peak traffic flow. Worst case conditions of active sport fishing weekend and summer holiday recreational traffic result in traffic volumes exceeding capacity over a short afternoon period. Mitigation to address boat traffic in the proposed project include widening the entrance channel, traffic control, implementation of a permanent traffic control tower, or limiting vessel size.

Alternative 1 would result in a 21 percent reduction in boat traffic congestion under average existing conditions and ten percent reduction during peak existing conditions. The reduction to 400 slips also reduces the impacts of congestion at the entrance channel, thereby reducing the need for any modifications to the entrance channel.

Alternative 2 would have the same level of boat traffic as the proposed project. Alternative 3 would not meet the demand for additional boat slips and would not generate additional boat traffic. Further discussion on marina traffic is contained in Section 4.8.

Police, Fire and Medical Services

The proposed project will impact police, fire and medical services due to an increase in de facto population and increased on-site activity. Alternatives 1 and 2 would have similar levels of impact as the proposed project due to increased on-site activity. Further discussion on police, fire and medical services are contained, respectively, in Sections 4.10.1, 4.10.2 and 4.10.3.

Drainage and Storm Water Facilities

The proposed project will increase drainage flows, quantities, velocities, erosion, and sediment runoff.

Alternative 1 involves a reduction of the project density that would reduce storm runoff from the various land uses due to a reduction in impervious surfaces associated with hotel and time-share development and to the creation of more open space. However, roadway areas will increase by about 30 percent in Alternative 1. Storm runoff from proposed streets would therefore increase; thus requiring additional drainage facilities and possibly resulting in no net savings. The golf course in Alternative 2 may also change drainage characteristics from those of the proposed project and may not reduce impacts. Alternative 3 would result in no change in existing conditions and no improvements to drainage infrastructure. Further discussion on drainage and storm water facilities is contained in Section 4.10.5

Wastewater Facilities

The proposed development is located within the service area of the Kealakehe WWTP and a sewer system will be installed that connects to the WWTP. The sewer system will be comprised of a network of gravity sewers, force mains, and pumping stations which collect and convey wastewater to the existing Kealakehe WWTP. Project improvements will incorporate the usage of recycled / R1 water. Improvements implemented by the proposed project will also accommodate the needs of the regional service population.

Alternative 1 would generate approximately 10 percent less wastewater flow than the proposed project. Wastewater flow in Alternative 2 is undetermined. Alternative 3 would result in no additional flow, as well as no improvements that will benefit the regional community. Further discussion on wastewater facilities is contained in Section 4.10.6.

Potable Water Facilities

The proposed project average daily water demand is estimated at 1.76 million gallons per day. Existing County sources are not adequate to meet this demand and source development is required. The developer is working with DLNR and two wells have been identified that will produce a sustainable yield that will serve the project. These wells will also serve water needs beyond the project.

Alternative 1 would result in net decrease of about five percent of potable water demand. Alternative 2 may have a lower water demand than the proposed project as long as potable water is not used for irrigation. Alternative 3 would result in no additional flow, as well as no source development that will benefit the regional community. Further discussion on potable water facilities is contained in Section 4.10.8.

Energy and Communications

Regarding Alternative 1, preliminary estimates for electrical, telecommunications, and cable resulted in a net demand load that remains similar to the proposed project. Further discussion on energy and communications is contained in Section 4.10.9.1.

The proposed project will increase the demand for electrical energy and telecommunications. The demand would be reduced in Alternative 1 because the number of boat slips and units would decrease. Similarly, Alternative 2 would have fewer units than the proposed project and therefore reduce energy demands. Further reduction in energy demand for either alternative could be achieved by using seawater air conditioning (SWAC) and other energy reduction measures, as planned by the developer. Further discussion on energy and telecommunications is contained in Section 4.10.9.2.

Water Features and Lagoons

The proposed project includes a brackishwater pond, lagoons, and marine life exhibits supplied by clean seawater. The water features in Alternative 1 would significantly decrease by 74 percent from 19 acres in the proposed project to five acres in Alternative 1. This decrease in water features would result in a corresponding decrease in water source requirements and seawater discharge. Alternative 2 does not include the seawater features. Alternative 3 would result in no additional demand for water source requirements and seawater discharge.

2.2.2 Conformance with Public Plans and Policies

State of Hawai‘i

Chapter 343, Hawai‘i Revised Statutes

Compliance with this chapter is effected, as described in Section 5.1.1 in regard to the proposed project and the alternatives discussed.

- State Land Use Law, Chapter 205, Hawai‘i Revised Statutes

  The discussion in Section 5.1.2 is directly applicable to Alternative 1, the proposed project. Alternative 1 will involve a setback of 400 feet that increases to 600 feet along the southern portion of the project site’s shoreline area. Alternative 2 does not provide for such a setback, but may still require approvals from DLNR for cultural, recreational, and community uses and structures within the Conservation district.

- Coastal Zone Management Program, Chapter 205A, Hawai‘i Revised Statutes

  Recreational Resources:

  In addition to the discussion of consistency with the associated objective and policies, as described in Section 5.1.3, the reduction from the proposed project’s 800-slip marina to a 400-slip marina under Alternative 1 will still expand the region’s boating opportunities and support facilities. The existing harbor entrance will still be utilized under this alternative; however, potential risks relating to boat traffic and congestion in the marina entrance area will be reduced significantly. The 400-600 foot shoreline setback, public parks, trails, cultural areas, community facilities, and marine science center remain important recreational components under Alternative 1.

Alternative 2 includes a golf course component, which would add a more passive recreation to the active and social components, such as boating, fishing, swimming, trails, walkways, parks, marine life, educational and interactive areas that are also part of the project. The golf course would enhance the range of leisure and recreational opportunities offered at Kona Kai Ola.

Alternative 2, like the proposed project, will expand the region's boating opportunities and support facilities through its 800-slip marina. However, the potential adverse impacts of increased boat traffic from the size of the marina are significant enough to offset the benefits of increased boating opportunities.

Coastal Ecosystems:

The discussion in Section 5.1.3 is directly applicable to Alternative 1.

Alternative 1 not only reduces the number of slips proposed by 50 percent, but it also reduces the size of the marina from 45 acres to 25 acres. The 25-acre marina will increase the body of water within the existing harbor, but to a significantly lesser extent than the proposed project's estimated increase, which is also applicable to the 45-acre size that is proposed for the marina under Alternative 2.

The findings of the Harbor Water Quality Modeling Study conclude that a reduction in the size of the harbor expansion is an alternative that will mitigate the risk of significant impacts upon water quality within the marina and existing harbor. Accordingly, the reduction in both the number of slips and the size of the marina basin under Alternative 1, in combination with proper facilities design, public education, and enforcement of harbor rules and regulations, would result in fewer long-term impacts to water quality and coastal ecosystems. Short-term (construction-related) impacts would likely remain the same although the reduction in the total acreage of excavation is expected to result in a shorter duration of such impacts.

In addition to its 800-slip marina and potential adverse impacts upon water quality and the marine environment, Alternative 2 includes a golf course component, which has the potential to impact coastal ecosystems by increasing the nutrient loading in surface runoff and groundwater and also by introducing pesticides, herbicides, and other chemicals common in golf course use and management into the nearshore waters surrounding the project site.

Economic Uses

Although reduced in the number of slips, the smaller marina under Alternative 1 will nevertheless serve public demand for more boating facilities in West Hawai'i and is consistent with the objective and policies and discussion set forth in Section 5.1.3. The economic impacts of Alternative 2, while comparable to those of the proposed project's marina development, are notably marginal as to the golf course component, based on the marketability analysis that indicates a condition of saturation within the region.

Coastal Hazards

The discussion and considerations set forth in Section 5.1.3 are also applicable to Alternatives 1 and 2 and indicate compliance with the objective and policies addressed. Tsunami risks mainly affect the large shoreline setback area that is proposed for the project and Alternative 1. Alternative 2 projects a transient accommodation site that is partially within the tsunami hazard zone and thus carries a higher hazard risk. However, the essential requirement for these alternatives, as well as the proposed project, is a well-prepared and properly implemented evacuation plan.

Beach Protection

Discussion and considerations set forth in Section 5.1.3 are also applicable to Alternatives 1 and 2 and indicate compliance with the objective and policies addressed. Alternative 1 and, to a lesser extent, Alternative 2, will retain the shoreline area in its natural condition.

Similar to the proposed project, Alternative 1 provides for a shoreline setback of considerable width within which no structure, except for possible culturally-related structures, would be allowed. Alternatives 1 and 2 will thus be designed to avoid erosion of structures and minimize interference with natural shoreline processes.

Marine Resources

The discussion in Section 5.1.3 is also applicable to Alternative 1 which is described to be an alternative that is specifically projected to mitigate anticipated adverse impacts on water quality and the marine environment that might otherwise result from the original harbor design and scale, which is also incorporated in Alternative 2 . The reduced marina size under Alternative 1 is projected to meet water quality standards and enable greater compliance with the objective and policies addressed in this section.

Alternative 2 includes a golf course component and thus the potential to adversely impact marine resources by increasing the nutrient loading in surface runoff and groundwater and also by introducing pesticides, herbicides, and other chemicals common in golf course use and management into the nearshore waters surrounding the project site.

Hawai'i State Plans, Chapter 226, Hawai'i Revised Statutes

Section 226-4 (State goals), 5 (Objectives and policies for population, and 6 (Objective and policies for economy in general):

The discussion in Section 5.1.4 is applicable to Alternatives 1 and 2, in addition to the proposed project. These development concepts generally conform to the goals, objectives, and policies set forth in these sections because they will provide some degree of economic viability, stability, and sustainability for future generations. Kona Kai Ola will convert essentially vacant land into a mixed-use development with a distinctive marina and boating element, providing a wide range of recreational, business, and employment opportunities to the community.

Section 226-8 Objective and policies for the economy – the visitor industry:

Alternatives 1 and 2 will be consistent with the State's economic objective and policies relating to the tourism industry for the same reasons that are discussed in regard to the proposed project in Section 5.1.4. They will incorporate JDI's commitment to sustainability principles in the planning and design of the development concepts in Alternatives 1 and 2. Although the total hotel and time-share unit count is reduced to approximately 1,500 in Alternatives 1 and 2, the transient accommodations component of these alternatives will still further the State's objective and policies for increased visitor industry employment opportunities and training, foster better visitor understanding of Hawai'i's cultural values, and contribute to the synergism of this mixed-use project concept that addresses the needs of the neighboring community, as well as the visitor industry.

Section 226-11 Objectives and policies for the physical environment: land-based, shoreline and marine resources:

Alternative 1 is expected to involve less potential adverse impacts upon these environmental resources than the proposed project. Likewise, and Alternative 2 would have less adverse impact because of its reduction in the size of the marina and in the total hotel and time-share unit count. Alternative 1 carries less potential risk to water quality and related impacts upon the marine environment and anchialine pool ecosystems. Although approximately three anchialine pools are expected to be destroyed, the great majority of pools will be preserved within and outside of the proposed 400-foot shoreline setback.

The golf course component in Alternative 2 has the potential to impact marine resources by increasing the nutrient loading in surface runoff and groundwater and also by introducing pesticides, herbicides, and other chemicals common in golf course use and management into the marina basin and nearshore waters surrounding the project site. It also has the potential to adversely affect the anchialine pools by introducing the chemicals into the pond systems.

Section 226-12 Objective and policies for the physical environment: scenic, natural beauty, and historic resources:

The discussion in Section 5.1.4 is directly applicable to Alternative 1 and describes the compliance with the objective and policies addressed.

The golf course component of Alternative 2 would create a park-like view that would potentially enhance the beauty of the project site and surrounding areas when considered in combination with the existing rugged natural beauty of the area.

Just as with the proposed project, Alternatives 1 and 2 would also be designed to blend with the natural terrain and to honor and protect the cultural history, resources, and practices of these lands.

Section 226-13 Objectives and policies for the physical environment: land, air and water quality:

As stated above, because of the reduction in both the number of slips and the size of the marina basin, with proper facilities design, public education and enforcement of harbor rules and regulations, Alternative 1 is anticipated to cause fewer long-term impacts to water quality than either the proposed project or Alternative 2. Based on the findings of the Harbor Water Quality Modeling Study, water quality resulting from a reduced marina basin size as proposed under Alternative 1 is expected to be similar to existing conditions.

As previously noted, Alternative 2 has the potential to adversely impact water quality by increasing the nutrient loading in surface runoff and groundwater by introducing pesticides, herbicides and other chemicals common in golf course development and maintenance into the marina basin and nearshore waters surrounding the project site.

Section 226-14 Objectives and policies for facility systems - general:

Alternatives 1 and 2 will conform to the objective and policies of this section on the grounds that are discussed in regard to the proposed project in Section 5.1.4. The master-planning and phasing of the project concepts under these alternatives will be coordinated with associated public and private infrastructural planning and related private and public infrastructural financing. The cost of the marina construction and project-related infrastructure is to be borne by the developer, resulting in considerable savings for the public. In addition, the projected lease revenue from these public lands will provide additional public benefits by establishing a revenue stream for capital improvements and maintenance of a range of State facilities.

Section 226-15 Objectives and policies for facility systems - solid and liquid wastes:

In addition to the developer’s commitment to sustainable development design, the project will involve upgrades to the County of Hawai‘i’s Kealakehe Wastewater Treatment Plant to meet current needs, as well as the project’s future needs. This commitment is applicable to Alternatives 1 and 2, as well as the proposed project that is discussed in Section 5.1.4.

Section 226-16 Objectives and policies for facility systems – water:

The discussion of water conservation methods and the need to secure additional potable water sources in Section 5.1.4 is also applicable to Alternative 1 and demonstrates conformity to the objective and policies for water facilities. Alternative 2 involves greater irrigation demands in regard to its golf course component and greater potable water demands for human consumption than those for Alternative 1. Alternative 2 is expected to face more serious challenges in securing adequate and reliable sources of water.

Section 229-17 Objectives and policies for facility systems – transportation:

Alternatives 1 and 2 will conform to this objective and policies because they will present water transportation opportunities, including the possible use of transit water shuttles to Kailua-Kona, as described in regard to the proposed project in Section 5.1.4.

Section 226-18 Objectives and policies for facility systems – energy:

Alternatives 1 and 2 conform to these objective and policies through the use of energy efficient design and technology and commitment to the use and production of renewable energy to serve the project's needs. Solar energy production, solar hot water heating, and the use of deep cold seawater for cooling systems are currently identified as means of saving substantial electrical energy costs for the community and the developer.

Section 226-23 Objectives and policies for socio-cultural advancement – leisure:

Alternative 1 conforms to this objective and related policies for the reasons offered in Section 5.1.4 in regard to the proposed project. Alternative 1 will be of greater conformity with the policy regarding access to significant natural and cultural resources in light of the 400-600 foot shoreline setback that has been designed for this alternative.

Although it does not propose the considerable shoreline setback that is planned for Alternative 1, Alternative 2 is consistent with this objective and related policies in incorporating opportunities for shoreline-oriented activities, such as the walking trails. In addition, the golf course component adds a more passive recreation alternative to the active and social components, such as boating, fishing, swimming, trails, walkways, parks, marine life educational and interactive areas that are also part of the project. The golf course would enhance the range of leisure and recreational opportunities offered at Kona Kai Ola.

Section 226-25 Objectives and policies for socio-cultural advancement-culture:

The discussion in Section 5.1.4 is relevant to Alternatives 1 and 2 and demonstrate their conformity the objective and policies of this section.

Both alternatives involve the preservation and protection of cultural features that have been identified by the Cultural Impact Assessment and archaeological studies for the project area. Both provide for public shoreline access, and both will continue the policy of close consultation with the local Hawaiian community and cultural and lineal descendants in the planning of cultural resource preservation and protection.

Section 226-103 Economic priority guidelines:

Alternatives 1 and 2 conform to these guidelines for the same reasons that are set forth in Section 5.1.4. They involve private investment in a public project that will create economic diversification through a mix of marina, industrial, commercial, visitor, and cultural facilities. This presents a wide range of entrepreneurial opportunities, long-term employment opportunities, and job training opportunities.

Section 226-104 Population growth and land resources priority guidelines:

As described in Section 5.1.4, the policy support for the proposed project also extends to the similar development concepts considered in Alternatives 1 and 2. Those alternatives conform to the guidelines of this section because they involve an urban development under parameters and within geographical bounds that are supported by the County's General Plan, a preliminary form of the Kona Community Development Plan, the County's Keahole to Kailua Regional Development Plan, and the reality of being located along the primary commercial/industrial corridor between Keahole Airport and Kailua-Kona. As with the proposed project, the development concepts of Alternatives 1 and 2 are essentially alternatives for the implementation and "in-filling" of the urban expansion area in North Kona.

DHHL Hawai'i Island Plan

This 2002 plan projects DHHL's Honokōhau makai lands for commercial use. As compared to the proposed project and Alternative 2, Alternative 1 presents an expanded commercial component that provides greater compliance with the plan, while addressing certain beneficiaries' concerns about the scale of the marina originally required in the Project. Alternative 2 also conforms to the recommended commercial uses in the makai lands but to a lesser degree than Alternative 1 because of its more limited commercial component. Like the proposed project, its marina size and number of slips raise environmental issues, as more specifically discussed in Part 3, and community concerns.

County of Hawai'i General Plan

HCGP Section 4 – Environmental Quality Goals, Policies and Courses of Action:

Alternative 1 is consistent with this section. It presents a reduction in both the number of slips and the size of the marina basin that, in combination with proper facilities design, public education and enforcement of harbor rules and regulations, would result in very few long term impacts to water quality. Based on the findings of the Harbor Water Quality Modeling Study, water quality would remain similar to existing conditions.

Alternative 2 is the least consistent with this section. In addition to the potential significant impacts of its 800 slip marina basin, its golf course component has the potential to adversely impact marine resources by increasing the nutrient loading in surface runoff and groundwater and also by introducing pesticides, herbicides and other chemicals common in golf course use and management into the nearshore waters surrounding the project site. It also has the potential to adversely affect the anchialine pools beyond their current conditions by introducing such substances into the pool systems.

HCGP Section 7 – Natural Beauty Goals and Policies:

Alternative 2 conforms to some degree with this section. Its golf course component would create a park-like view that would potentially enhance the beauty of the project site and surrounding areas when considered in combination with the existing rugged natural beauty of the area, as demonstrated in other makai golf courses within the region.

HCGP Section 8 – Natural Resources and Shoreline:

Alternative 1 is most consistent with the goals and policies of this section. It would require considerably less marina excavation than the proposed project and Alternative 2 and would reduce the potential risk of long-term adverse impacts to water quality. Based on the findings of the Harbor Water Quality Modeling Study, water quality would remain similar to existing conditions with the degree of reduction in marina basin size that is proposed under Alternative 1. This reduction is also expected to reduce potential impacts upon anchialine pools and their ecosytems, as well as shoreline and marine resources that are affected by water quality. Alternative 1 also retains the shoreline preservation and protection concepts that are proposed in and described for the Project.

HCGP Section 10 – Public Facilities Goals and Policies:

The discussion in Section 5.2.1. in relation to the proposed project is applicable to Alternatives 1 and 2. Improvements to public facilities are are integral to the Kona Kai Ola development. The provision of additional boat slips and numerous road improvements, including a makai extension of Kuakini Highway south to Kailua-Kona are incorporated into plans for the project's development. In light of these elements, Alternatives 1 and 2 are consistent with the goals and policies of this section.

HCGP Section 11 – Public Utility Goals, Policies:

As with the proposed project, Alternatives 1 and 2 are consistent with the goals and policies of this section, based on the relevant grounds set forth in Section 5.2.1. The developer is committed to design, fund, and develop environmentally sensitive and energy efficient utility systems to the extent possible, as described previously in Part 5. Its master planning provides for the coordinated development of such systems with the objective of achieving significant savings for the public. As previously-mentioned example, the project development involves the upgrading of the Kealakehe Wastewater Treatment Plant.

HCGP Section 12 – Recreation:

Alternative 1 is consistent with the goals, policies, and courses of action for North Kona in this section.

Although the number of slips is reduced under Alternative 1, the region's boating opportunities and support facilities will still be expanded. The existing marina entrance would still be utilized under this alternative. However, concerns relating to increased activity leading to increased congestion in the marina entrance area would be mitigated to a certain extent. The 400-600 foot shoreline setback, public parks, trails, cultural areas, community facilities and marine science center remain important components of Alternative 1.

The golf course component of Alternative 2 would add a more passive recreation to the active and social components, such as boating, fishing, swimming, trails, walkways, parks, marine life, educational and interactive areas that are also part of the project. The golf course would enhance the range of leisure and recreational opportunities offered at Kona Kai Ola. Alternative 2 is also considered to be consistent with this section.

HCGP Section 13 and 13.2 – Transportation:

The reduced marina component under Alternative 1 will still provide transportation opportunities and provide for possible use of transit water shuttles to Kailua-Kona, although to a lesser degree than under the proposed project and Alternative 2 . However, in each scenario, internal people-movers are planned, and numerous roadway improvements are planned for coordination with public agencies, including but not limited to the construction of the Kuakini Highway extension between Honokōhau and Kailua-Kona. Accordingly, both Alternatives 1 and 2 are consistent with the goals, policies, and courses of action for North Kona under these sections of the General Plan.

HCGP Section 14.3 – Commercial Development:

For the reasons presented in the discussion under Section 226-104 of the State Plan, the planned commercial component under Alternatives 1 and 2 are consistent with this section.

HCGP Section 14.8 – Open Space:

Alternatives 1 and 2 are consistent with the goals and policies of this section. Alternative 1 provides a considerable (400-600 foot) shoreline setback along the entire ocean frontage of the project site as a means of protecting the area's scenic and open space resources, as well as natural and cultural resources. Although it does not incorporate the shoreline setback planned in Alternative 1, Alternative 2 provides a golf course component would contribute to the amount of open space that is currently proposed and allow additional view corridors to be created.

Community Development Plans

Community development plans are being formulated for different regions in the County in order to supplement the County's General Plan. The Kona Kai Ola project is located in the Kona Community Development Plan (CDP) area. Maps associated with the preliminary work phases

of the Kona CDP include the Kona Kai Ola project site within the “Preferred Urban Growth” boundary of the North Kona district. The Kona CDP process is guided by a Steering Committee composed of a broad cross-section of the community. The Steering Committee will eventually complete its work and recommend the CDP’s adoption.

After the DEIS was published, the Kona CDP has progressed to the development of plans for the major urban growth corridor north of Kailua-Kona. The Kona CDP has produced a draft plan showing a transit oriented development that includes a midlevel public transit corridor along the mauka residential elevation, and a makai transit corridor that runs along a proposed new frontage road just makai and parallel to Queen Kaahumanu Highway. The development plan for Alternative 1 includes the Kuakini Highway as part of this proposed frontage road and transit line from Kailua Kona to the Kealakehe area, along with a transit stop at Kona Kai Ola. The Alternative 1 plan also includes a road that could be extended to be part of the proposed frontage road should it be approved and implemented. In addition, the Kona CDP has continued to emphasize the principles of smart growth planning with mixed use urban areas where people can live, work, play and learn in the same region. Kona Kai Ola has been specifically designed to be consistent with this policy in order to provide a stable employment base close to where people live in the mauka residential areas already planned for DHHL and HHFDC lands.

It should be noted that currently and over the years, the 1990 Keāhole to Kailua Development Plan (K-to-K Plan) guides land use actions by the public and private sectors. It is intended to carry out the General Plan goals and policies related to the development of the portion of North Kona area, including the Kona Kai Ola site. The “Preferred Growth Plan” of the Keāhole to Kailua Development Plan identifies the project site as a new regional urban center to include commercial, civic, and financial business related uses, an expanded “Harbor Complex,” a shoreline road, and a shoreline park. The proposed project and the development concepts in Alternatives 1 and 2 are therefore consistent with the recommendations in the Keāhole to Kailua Development Plan.

Hawai‘i County Zoning

As shown on Figure AA, the project site is zoned “Open”. Under Section 25-5-160 of the Hawai‘i County Code, “The O (Open) district applies to areas that contribute to the general welfare, the full enjoyment, or the economic well-being of open land type use which has been established, or is proposed. The object of this district is to encourage development around it such as a golf course and park, and to protect investments which have been or shall be made in reliance upon the retention of such open type use, to buffer an otherwise incompatible land use or district, to preserve a valuable scenic vista or an area of special historical significance, or to protect and preserve submerged land, fishing ponds, and lakes (natural or artificial tide lands)”.

Some of the proposed uses at Kona Kai Ola are permitted uses in the Open zone such as:

- Heiau, historical areas, structures, and monuments;
- Natural features, phenomena, and vistas as tourist attractions;
- Private recreational uses involving no aboveground structure except dressing rooms and comfort stations;

- Public parks;
- Public uses and structures, as permitted under Section 25-4-11.

In addition to those uses permitted outright, the following uses are permitted after issuance of a use permit:

- Yacht harbors and boating facilities; provided that the use, in its entirety, is compatible with the stated purpose of the O district.
- Uses considered directly accessory to the uses permitted in this section shall also be permitted in the O district.

The proposed time-share and hotel units and commercial uses would not be consistent with the zoning designation of “Open”. Project implementation therefore requires rezoning of portions of the project to the appropriate zoning category or use permits for certain uses.

Special Management Area

As shown in Figure AB, the entire project area up to the highway is within the coastal zone management zone known as the Special Management Area (“SMA”). At the County level, implementation of the CZM Program is through the review and administering of the SMA permit regulations. Kona Kai Ola complies with and implements the objectives and policies of the Coastal Zone Management (CZM) Program, and a full discussion is provided in Section 5.1.3. The development concepts in the proposed project and Alternatives 1 and 2 will be subject to applicable SMA rules and regulations.

United States Department of the Interior

NATIONAL PARK SERVICE
Kaloko-Honokohau National Historical Park
73-4786 Kanalani St., Suite 14
Kailua-Kona, HI 96740

IN REPLY REFER TO:
L7621

February 6, 2006

Mr. Scott Condra
Jacoby Development LLC
171 17th Street, NW Ste 1550
Atlanta, Georgia 30363

Subject: National Park Service Comments on the Proposed Kona Kai Ola Project Draft Environmental Impact Statement

Dear Mr. Condra:

This letter includes our general and specific comments (attached) on the Kona Kai Ola Draft Environmental Impact Statement (DEIS), and is sent in follow up to the National Park Service's (NPS) comments sent August 18, 2006 concerning the scoping notice for this proposed development. The NPS has serious concerns about the proposed project and its potential impacts on Kaloko-Honokohau National Historical Park. The project is located on the southern boundary of the Park and includes approximately 15.5 acres of land within the Park's legislated boundary and the Honokohau Settlement National Historic Landmark. The project will have significant, irreversible adverse impacts to the cultural and natural resources that make the Park and the National Historic Landmark nationally significant. The mitigations proposed in the DEIS are inadequate to reduce the potential significant impacts of the project to the Park.

The DEIS does not meet the requirements of an environmental impact statement under HAR 11-200. To meet these legal requirements, the DEIS would need to be re-issued with reduced project alternatives and no action alternative evaluated and sufficient impact analysis. As currently proposed, the full-build alternative would result in unacceptable impacts to the NPS managed lands; water resources including the nearshore and offshore marine waters, groundwater, and anchialine pools; and candidate, threatened and endangered species. The only permissible alternative is the No Action alternative.

Sincerely,

Geraldine K Bell
Superintendent

CC: Department of Hawaiian Home Lands
Department of Land and Natural Resources
Hawaii Office of Environmental Quality Control
Oceanit
Hawaii County Planning Department
State Historic Preservation Officer
Advisory Council for Historic Preservation
U.S. Fish and Wildlife Service
NOAA Fisheries Protected Resources Division

NATIONAL PARK SERVICE
GENERAL COMMENTS ON KONA KAI OLA DRAFT EIS

Environmental Review
The DEIS does not satisfy the environmental review process under HRS 343 and HAR§ 11-200-23 because it does not submit for review all proposed project components that may have significant impacts, does not disclose and describe all identifiable impacts, does not respond to comments submitted during the review process, and does not adequately explore mitigation measures. The document appears to merely be "a self-serving recitation of benefits and a rationalization of the proposed action" (HAR §11-200-14) in which impacts are downplayed throughout.

Alternatives
The DEIS asserts that only the full build alternative is feasible. This assertion defeats the purpose of environmental review, which is to give decision makers and the public the opportunity to consider environmental impacts of differing alternatives to achieve the purpose and need for the project. The State of Hawaii Guidebook for the Environmental Review Process states an Environmental Impact Statement "must present alternative, methods, modes, or designs of the proposed action (Guidebook, page 21)."

The DEIS states: "*Hence, the agreements and leases between the State and JDI indicate that the no-action alternative has been rejected at this time*" (page ii). The assertion that the No Action alternative is infeasible suggests that the agencies may have been pre-decisional in eliminating alternatives prior to environmental analysis. The NPS has concerns because it appears agreements were concluded prior to required environmental review. As noted in the DEIS: "*The agreements and leases between the State and JDI stipulate the parameters of development for this site in terms of uses, quantities and size of many features, resulting in a limited range of land uses*" (page ii). What benefit is the environmental process if the decisions about development have already been made? In addition, the change in county zoning of part of the property from "Open" to "Urban Expansion Area" should not be made without the benefit of the environmental analysis.

Scientific Study
The DEIS contains a substantial number of statements that are not supported by scientific data or references to published literature, or cannot be verified because of lack of information on methodology in the Appendices. Many statements in the document are contradictory, often on the same page. Some studies in the DEIS, upon which conclusions regarding impacts and their significance are based, are wholly inadequate in statistical sampling design and effort, and use methodologies that are inappropriate to establish baseline conditions or to detect the presence of rare species. Application of information gathered in these inadequate studies results in conclusions that are unsupported and invalid. Where possible, we have identified these shortcomings in the Specific Comments below.

The bathymetric data used for models and for general discussion about impacts to the nearshore environment lacks the resolution requisite for 'best possible' interpretations. Many processes (waves, vertical mixing, dispersion of nutrients) are strongly dependent on the depth and morphology of the nearshore zone. The lack of high-resolution bathymetric data in the DEIS also affects the validity of some statements and findings.

Hazards

There is little or no consideration given to the sporadic natural and anthropogenic events that can and will occur. Events include periods of extremely large waves, heavy rain and coastal run-off, oil/fuel spills in the harbor, and other similar events. Large waves from a tsunami or major storm will likely hit this part of the Kona coast at some point in time. The DEIS also lacks citation of key current reports regarding this topic, such as: Fletcher et al., 2002. *Atlas of Natural Hazards in the Hawaiian Coastal Zone.* Given that such events often are the processes that most affect both human safety and ecosystem health, critical analysis of the probability and outcome of such events should have been considered in the DEIS.

Water Resources

The source of water supply for the Kona Kai Ola project demand (2.6 MGal/day) must be identified and included in the DEIS in order to adequately assess project impacts to groundwater supply, flow to coast, and proximal environment. If local groundwater sources are tapped to meet the project demands, the DEIS is insufficient to address impacts. Saltwater intrusion into the local aquifers may affect future groundwater use and the local ecosystem. The DEIS does not provide the necessary quantitative data to describe or assess the environmental impacts to regional groundwater and to the National Park, whose cultural and natural resources are dependent on groundwater quantity, and quality. Therefore conclusions regarding groundwater in the DEIS such as "*it is highly unlikely that existing groundwater flows to the Kaloko-Honokohau pond system ... will be impacted by the proposed marina…*" (page iii) are scientifically unsupported and ignore the cumulative impacts of groundwater withdrawal occurring in the local area.

The statement "*…water quality will be improved, thereby generating a positive impact on the nearshore marine environment*" (page iii), is repeated throughout the document and is misleading and unsupported by studies or data in the DEIS. The discharge of ocean water (75 Mgal/d) from the lagoon and water feature will have a significant negative impact on the nearshore environment because:

- The added discharge is 20-fold higher than the current discharge, resulting in a net higher load of nutrients.
- There is a greater degree of vertical mixing with the addition of the more saline (dense) ocean water, making the nutrients more available for the benthic communities, which can lead to irreversible impacts on reef communities such as the invasive algae growth plaguing Maui County.
- There will be an additional increase in added pollutants and nutrients because the lagoons will act as a drainage receptacle for polluted stormwater runoff from road ways, landscaping, etc.
- There will be additional nutrient loading in the lagoons due to biological activity of captive animals.

Although the DEIS claims that nutrient **concentration** flowing through the harbor will be reduced in by the addition of 75 Mgal/d of ocean water, the fact, that was not disclosed in the DEIS, is that the **total load (i.e., amount)** of nutrients to the nearshore will ***be greater*** due to the higher flow rates. The DEIS does not consider the flux, pathways, or impact on benthos of an increased nutrient load. We could not find scientific evidence in the DEIS that supports the claim that water quality in the nearshore waters will be improved by the addition of 75 Mgal/d ocean water.

Mitigation
Mitigation throughout the DEIS is "*recommended*" and not required. However, the analysis is based on the impact reducing effects of mitigations integrated into the proposed action. Thus, the public has no guarantee that the mitigations will be implemented, or where appropriate, enforced. Nor is the impact analysis straightforward with the level of impact unless the mitigations are required. There is no commitment from the project proponents to implement the mitigations proposed, an identification of the responsible party, a timetable for implementation, and a monitoring and reporting requirement.

Endangered Species Consultation
The DEIS does not identify consultation with the U.S. Fish and Wildlife Service and NOAA Fisheries in relation to impacts to endangered species. Because of the potential impacts to the several protected species, it appears that consultation under Section 10 of the Endangered Species Act is required. The DEIS should state "Endangered Species Act" under Federal Permits and Approvals.

Marine Mammals and Sea Turtles
The DEIS is completely inadequate in its assessment and discussion of the current biological conditions of these protected marine species in the proposed project area, and in the discussion of potential impacts and mitigation. The supporting studies are grossly insufficient. Impacts to these species, particularly marine turtles and spinner dolphins will be long-term adverse significant impacts. No reasonable mitigation measures are proposed.

Cultural Resources
The DEIS does not identify the Ala Kahakai National Historic Trail nor the Honokohau Settlement National Historic Landmark (which is an environmental review trigger not mentioned in Section 1.7). At the point at which the U.S. Army Corps of Engineers would consider permitting the proposed project, the USACE will be required to evaluate the project effects under both the National Environmental Policy Act and the National Historic Preservation Act, including effects on historic properties and consultation with the Advisory Council on Historic Preservation.

It appears the project will permanently destroy 101 (page 69) to 154 (page 67) known archeological sites (the DEIS is unclear about these numbers) and the mitigation that is proposed is data collection. Greater mitigation is required to reduce this impact and the permanent loss of these features. Trail 21588 and trail 7704 must be preserved.

All anchialine pools will be destroyed as a result of the proposed project. This destruction is unacceptable. These pools are both cultural and natural resources that are an important component of the cultural landscape, as well as habitat for two endemic, candidate endangered species. The suggestion that "*these ponds are already degraded*" (page iv), is not supported by a 2002 USGS survey of the pools and their fauna. This statement and others like it are deliberately misleading to the readers unfamiliar with the site and pools in its portrayal of the condition of the pools.

Recreation

The DEIS does not include an analysis of recreational impacts. It would appear that a study of the current uses of this shoreline and the impacts of the project should have been in the DEIS, including:

- Identifying the types of public amenities that will be provided in the parklands.
- Identifying the process for access including potential parking and requirements, fees, or permits for coastal access.
- Identifying impacts, e.g., no discussion of the potential impact of a 300% increase in boat traffic to the safety of the important free diving and spear fishing communities in Kona.
- Identifying the improvements to the open space and parks in the four phases of development. (Figure F does not or identify when improvements to recreation will be implemented.)

Noise

There is no discussion of noise impacts to visitors to Kaloko-Honokohau National Historical Park. Adjacent to the park boundary, seven acres are proposed as "Marina Industrial (page 12)" and will likely contain the most audible sources of noise in the entire proposed development after construction ceases. No information in the DEIS exists concerning noise impacts from construction activities such as pile driving and stationary sources such as deep water pumping equipment on park visitors, cultural activities in the park, and sensitive resources such as nesting birds.

Visual Impacts

No visual impact analysis for the surrounding area is included in the DEIS. No grading plans or site maps are provided, only a conceptual plan and a statement that hotels will be "*coconut tree height*" on 20-50' graded land. It is unacceptable to provide only a conceptual plan for review. Potential impacts to visual resources (makai-mauka views, views from the National Park), the terrestrial environment, water resources, cultural and archeological resources, and drainage cannot be assessed from the conceptual site plan because no elevation view is provided. Additionally, no discussion is made of night-sky pollution.

Sustainability

It appears contradictory for the DEIS to state that the "*vision for Kona Kai Ola is an environmentally sustainable marina focused development*" while proposing such a large and consuming development. A hard look at the impacts of the project does not bear out the stated vision, including:

- LEED Rating- The document commits that the project will go through the certification process but does not identify a goal for LEED rating. The DEIS did not commit the project to achieving a gold or platinum rating in order to meet the stated goals in the DEIS (page ii, 1st paragraph).
- Water- Is 2.6 million gallons a day (page vii) really sustainable, especially without an unidentified water supply and without full knowledge of the hydrologic implications of removing that amount of water?
- Energy- The DEIS discusses the environmental design and sustainable features but provides no hard commitments to meet those stated goals. For example, solar (page 124) is noted as a component of the project but there is no commitment to the percentage of solar that would be achieved. The DEIS did not provide the commitment the developer will make toward using a percentage of energy demand from renewable sources and include monitoring and reporting requirements to assure the public that those targets will be met. The DEIS does not quantify the amount of energy that would be required to pump the millions of gallons of water from the ocean for the proposed cooling system and the water aquarium feature.
- Air Quality- The air quality section identifies the Keahole Power Plant as a "*major industrial source of air pollution*" (page 26). However, the DEIS does not quantify the amount of energy that will be used daily, monthly, and yearly at the development and the impacts of that energy use on air quality.
- Wastewater- the DEIS identifies needed improvements at the wastewater treatment plant (page 122). However, the DEIS fails to identify who will be required to make the improvements to the plant, when they will be accomplished, and how that fits into the proposed development's schedule.
- Solid Waste- the assertion in the DEIS that "*an extensive recycling program that will reduce waste generated on site by 90 percent*" (page 103) is a good intention but has not been proven realistic. A waste reduction rate of 50% is considered standard. The goal appears equally ambitious because the DEIS provides no exact plans on the development of recycling and composting and how it will be achieved.
- Drainage- although JDI claims to be a sustainable developer, no discussion of innovative sustainable stormwater best management practices to protect receiving water bodies from nonpoint source pollution were offered in the DEIS. The majority of the proposed project site would be converted to impermeable surface. Surface water runoff during even low rainfall as described in the DEIS will carry pollutants and nutrients to the groundwater, and the harbor basin, via the standard county drywell system, which is a hole in the ground that does not filter pollutants. The constructed lagoon and water features would also be a drainage collection area with point source discharge to harbor waters and ultimately Class AA waters in the National Park.

Project Compatibility with Existing and Emerging Community.
Urban development is rapidly expanding along the Kailua-Kona, Queen Ka`ahumanu Highway corridor. However, within this corridor, Kaloko-Honokohau National Historical Park is a significant parcel and is a natural and cultural resource of the utmost value both to the State of Hawaii and the nation as a whole. The National Park represents some of the State's most important natural systems, habitats, and valued cultural, historical, and natural resources. These nationally significant resources are to be perpetuated and protected forever. The National Park also has significant economic value for the central Kona coast. Degradation of Park resources

would mean a negative economic impact for the region. Therefore, the new urban community must coexist with the National Park and to do so, must take significant measures to protect it.

Regional plans and urban development plans must take into consideration the presence of these resources, their physical and biological requirements for continued existence, and the necessity of protecting them for the benefit of the community and the nation. Environmental review for developments adjacent to a National Park must, therefore, be quite rigorous, more rigorous than what may be expected for properties not adjacent to a National Park. A landmark Findings of Fact, Conclusions of Law, and Decision and Order by the State of Hawaii Land Use Commission in 2002 stated, in considering development neighboring the National Park, "...for all proposed development adjacent to or near a National Park that raises threats of harm to the environment, cultural resources, or human health, precautionary measures should be taken to protect the National Park's cultural and natural resources, even if some cause and effect relationships are not fully established scientifically" (LUC 2002, Finding of Fact #165). For developments farther from Park boundary than the proposed Kona Kai Ola project, the LUC found that additional stringent measures of protection against nonpoint source pollution of groundwater must be taken for development adjacent to the National Park (LUC 2002, FF #307, #321; Decision and Order). Review of the DEIS shows that the proposed development is wholly incompatible with the National Park, and will have major, adverse long-term irreversible impacts to the Park and its cultural and natural resources. The scientific studies are inadequate to demonstrate "no impact" to the Park and therefore precautionary measures must be taken. No reasonable or effective mitigation are proposed to protect the National Park.

NATIONAL PARK SERVICE SPECIFIC COMMENTS ON KONA KAI OLA DEIS

Section 1.4 Purpose and Need for the Project

The purpose and need statement does not adequately describe the need for the proposed project at the full-scale preferred alternative. Nor does it provide adequate information required for public review. The lease agreement with the Department of Hawaiian Home Lands (DHHL), and the development agreement with the Board of Land and Natural Resources requiring the 45-acre basin and 800 slips along with the rational that this requirement was based upon, should be disclosed to the public for review and comment as an appendix in the draft environmental impact statement (DEIS). No information is provided to the public on how the DLNR-required build out density was determined. An environmental review is required for establishing these specific marina criteria. No explanation of the ratio of costs per acre of marina basin or per slip that requires the proposed density of the development is provided. Are the facilities for the lagoon system factored into this ratio of costs? The applicant, Jacoby Development Inc (JDI), states (Section 2, page 19) that "*the density proposed for the income generating features of the development must be sufficient to provide an acceptable level of economic return for JDI.*" However, no information is provided to the public on what constitutes an acceptable level of return for JDI that justifies the need for this scale of the development, or the inclusion of the water features (not required by the lease agreement).

The market analysis (Appendix B, page 12) points to the need for 200-300 slips, not 800, and the DEIS (page 13 Section 1.6) states that "*Installation of the boat slips would be constructed as the market warrants over the 15-year build out of the project.*" In phase 2 of the build out, 2-5 years into project, "*Approximately 100 slips will be built*" (Section 1.6.2, pg 15). The remainder of the slips is projected to be built in phase 3 and 4, 9-15 years into the project (Section 1.6.2, pg 16). Justification of need is not provided for committing the community of Kailua-Kona to a development of this magnitude (three hotels and 1800+ timeshare units, 19 acres of seawater "Water Feature") and foreclosing other future options for the area.

Section 1.5.2 Project Sustainable Design

There are large differences between silver, gold, and platinum LEED certification. It is not stated what degree of LEED certification JDI is proposing. A commitment in the DEIS to achieving platinum or gold rating would have to be made to meet stated goals in the DEIS (page ii).

Section 1.6.2 Phase 2

Figure F shows a large commercial parcel immediately adjacent to the National Park boundary and a marine industrial parcel, adjacent to water, close by. Will this parcel be developed similarly to other nearby commercial parcels, i.e., as light industrial or industrial? A 2002 decision by the Hawaii Land Use Commission found that for developments farther from Park boundaries than Kona Kai Ola, additional measures of protection against nonpoint source pollution of groundwater must be taken when development is adjacent to a National Park (Hawaii LUC 2002). No discussion is provided in the DEIS regarding impacts from industrial development, buffers, mitigation, and safeguards to protect National Park resources from commercial industrial park-generated pollutants associated with the project. Will pollution prevention plans be required for each lot? Will Covenants, Conditions, and Restrictions be developed for stormwater runoff from industrial lots as with other industrial parks neighboring the National Park (LUC 2002)? These questions were asked by the NPS in our response letter to the EIS preparation notice (Appendix A); however the response was unsatisfactory and only mentioned the LEED certification, not non-point source pollution controls. If the DEIS is intended to serve as the environmental review document for all parcels, then specific consideration of impacts and mitigation must be given in detail for all land use types. This document appears to focus only on the marina and water features.

Section 1.6.4 Phase 4
As written, the phasing of the project appears to include the entire basin excavation in Phase 2, but with only 100 slips installed at that time. Four hundred slips will be added during Phase 3, and the remaining 300 slips added during Phase 4 (15 years later). No mention, or analysis, in the DEIS is made regarding potential environmental impacts of adding new slips after the opening of the basin. Will there be pile driving (which will include noise effects) or sedimentation issues during these later installations? What mitigation measures are proposed at those times? (See comments regarding inadequacy of proposed mitigation for noise and sediment Section 3.9.5.2 and 3.3.4).

Section 1.7 Environmental Process
The DEIS does not disclose that an environmental review is also triggered by actions that "Propose any use within any historic site as designated in the National Register or Hawaii Register, as provided for in the Historic Preservation Act of 1966, Public Law 89-665, or Chapter 6E" [HRS 343-5(a) (4)], and that a portion of the project area includes significant features of the Honokohau Settlement National Historic Landmark (1962). All National Historic Landmarks (NHL) are on the National Register. All of the anchialine pools within the Kona Kai Ola project area are significant cultural features and are contributing elements to the NHL as described in its nomination. These features will be destroyed by the project action. The National Park Service pointed this fact out to JDI in our response to the EIS preparation notice (Appendix A). However the DEIS does not respond to these comments regarding the NHL, as required under HRS 343, except to copy a portion of our letter into Section 1.3 describing the authorization of the National Park. The Honokohau Settlement National Historic Landmark did not cease to exist upon authorization of the National Park. No mention is made in the DEIS of any contact or consultation with the Advisory Council on Historic Preservation regarding proposed impacts to the NHL. (See additional comments in Section 5)

Section 2 Alternatives Analysis
According to Hawaii Administrative Rules, Chapter 200, §11-200-17 (F). Content Requirements, Draft Environmental Impact Statement [relating to Alternatives]: "The section shall include a rigorous exploration and objective evaluation of the environmental impacts of all such alternative actions. Particular attention shall be given to alternatives that might enhance environmental quality or avoid, reduce, or minimize some or all of the adverse environmental effects, cost, and risks. Examples of alternatives include:

1. The alternative of no action;
2. Alternatives requiring actions of a significantly different nature which would provide similar benefits with different environmental impacts;
3. Alternatives related to different designs or details of the proposed actions which would present different environmental impacts;
4. The alternative of postponing action pending further study; and,

5. Alternative locations for the proposed project."

The single alternative considered in the DEIS is "*no action.*" Therefore the DEIS does not meet legislated requirements and cannot be accepted. Section 11-200-17 (L) of the HAR further requires "The statement shall also indicate the extent to which these stated countervailing benefits could be realized by following reasonable alternatives to the proposed action that would avoid some or all of the adverse environmental effects." Although there are many, one example is the DEIS does not explore the alternative of no lagoon and water features, which pose a significant threat to natural and cultural resources in the National Park waters. (See comments on the water feature impacts in Sections 3.9 and 4.10.10)

Section 3.3.4 Subsurface Geology, Anticipated Impacts and Recommended Mitigation.
The DEIS does not provide a current topographic map, descriptions of the proposed final topography, or clear estimates of ground and building elevations planned for the site. No opportunity exists for public review of how significantly the natural grade will be altered, or how the significant grading potentially impacts the following resources: visual resources (mauka to makai views, views from the National Park), terrestrial environment, water resources, cultural and archeological resources, and drainage. Potential impacts to these resources cannot be assessed from the conceptual site plan provided, because no proposed elevation view is given and no visual impact analysis of the proposed layout was made. Buildings up to 4-stories in height are proposed on 20-50' graded land (page 28). The DEIS states (pages 72, 113, 145) there will be a "*coconut tree height*" general limit on buildings. However, no actual metric is provided for this limit and it is not clear whether "*coconut tree height*" will be measured from the natural grade, new grade or a baseline of sea level.

Silt curtains to retain sediments are proposed for use when the new marina basin is opened to the coastal waters (page 25). The effectiveness of this mitigation for this size of construction is unstated. Additionally, no mitigation measures are proposed for the subsequent slip construction phases after the basin is open, or during land-based construction and grading, which will continue for some 11-15 years (Section 1.6 Phasing).

Section 3.4 Natural Drainage
The statement "*Even in the event of heavy rainfall, which is more than two inches in one hour (NOAA 2006) the porous nature of the ground is such that sheet flowing to the shore does not occur*" (page 26), is incorrect and unsupported by reports or data. Furthermore, "*more than 2 inches in 1 hour*" is not the National Weather Service (NWS) definition of "heavy rainfall." Examination of the NOAA 2006 website cited, also does not provide the definition stated in the DEIS. "Heavy Rainfall" is based on rate-of-fall and is defined by the NWS as "more than 0.3 inch per hour; more than 0.03 inch in 6 minutes. Rain seemingly falls in sheets; individual drops are not identifiable; heavy spray to height of several inches is observed over hard surfaces" (NWS 1997). Sheet-flow does occur on the project site. On July 29, 2006 the remnants of Hurricane Daniel passed the west coast of the Big Island. Between 7:00 and 8:00 pm, rainfall measuring 1.08 inches was recorded by the NPS remote automated weather station located on the northern boundary of the project site (data for this station can be accessed at the following web site http://www.wrcc.dri.edu/cgi-bin/rawMAIN.pl?hiHKAL). During that hour, NPS staff observed

large quantities of water flowing as sheet flow across both areas of natural, unpaved ground and man-made impervious surfaces carrying sediment into the existing harbor basin.

The DEIS does not describe the environmental impacts from stormwater runoff to the marina, and no measures to mitigate these impacts are provided in the proposed drainage system for the project. In fact, minimal information is given on the proposed drainage system, which is disproportionate to the large impact the fate of drainage will have. It is simply stated in the DEIS that drainage will be led "*to the ground*" (page 26, paragraph 2), discounting that this runoff will join the groundwater and exit into the harbor and ultimately the coastal waters. "Sheet flow" of storm runoff will occur on the proposed development. Surface water runoff during even low rainfall will carry pollutants and nutrients to groundwater and the harbor basin. The constructed lagoon and water features will also be a drainage collection area. The mitigation should take into account at least a 10-year storm event. Mitigation measures to address the quality of stormwater runoff should be presented. How fertilizers, pesticides, and volatile organic chemicals will be managed and minimized on site is not presented. The DEIS should outline the overall stormwater management plan, impacts, and mitigation measures for surface water drainage, and must not to defer this responsibility to the individual parcels or the County of Hawaii.

Section 3.5 Air Quality; Appendix C Air Quality Study
The project has the potential to significantly impact air quality. A quantitative analysis using updated models and local measurements for all air quality parameters was not conducted to assess the impacts from the proposed development to the region's air quality. The study in Appendix C is qualitative, which is insufficient to address the air quality issues at the site. The study relies on limited data measured far from the site, an outdated model using national average values, and incorrect assumptions regarding traffic flow in the surrounding area. Stating that carbon monoxide concentrations from vehicle emissions (as a result of the development) will remain within state and federal standards is not a measure of the impact to air quality from the proposed development. The proposed development will produce more vehicle emissions in an increasingly congested area. As a result, carbon monoxide concentrations will increase. Currently, air quality in the proposed development area is impacted by vehicle exhaust from a busy highway, mineral particles from land clearing activities (including highway expansion), airplane exhaust, two rock quarries, an asphalt plant, a solid waste dump, vog (aerosols from Kilauea volcano), local aerosol-producing activities, and to a much lesser extent by periodic incursions of Asian dust. These air pollution sources and concerns are not adequately addressed, and a quantitative study was not performed that shows current measurements in the project area of total suspended particulates, lead, nitrogen dioxide, carbon monoxide, ozone, and sulfur dioxide.

Section 3.7.1 Flora
A culturally important plant, the sedge makaloa (*Cyperus laevigatus*) was not included in the plant survey but exists along the edges of some anchialine pools on the site.

Section 3.7.1.2 Flora, Anticipated impacts and Recommended Mitigations
The DEIS proposes to mitigate project impacts to coastal native flora, including culturally important species, by establishing a protected 400-foot strip extending back from the shoreline (page 34, paragraph 4). However, according to Appendix G, marina construction will cut off the freshwater flow necessary for these plants to survive (Appendix G, page 4, par. 2: "*most of the*

trees will die off as well" as will "*brackish water vegetation currently in anchialine ponds.*"). Therefore a significant negative impact, as defined by HAR §11-200-12 B (1), to natural and cultural resources will result from the destruction of the water supply for these plant communities The DEIS does not discuss what water source will be provided to keep native vegetation in the 400-ft buffer. Non-potable water pumped from on site wells (proposed but not discussed in Section 3.8.2, page 40) and/or use of R2 or R1 water will each have significant impacts and consequences, and are not addressed in the DEIS.

Section 3.7.2.1 Fauna, Existing Conditions

Although the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*) was not recorded during the two morning and two evening surveys in February 2006 (page 34, & Appendix E, pages 4-5), bats are known to utilize the Honokohau Harbor and Kaloko-Honokohau National Historical Park (See Parrish 2005. http://rprs.nps.gov/research/ac/search/iars/Iar?reportId=36354). A 2005 survey conducted between March and July by the NPS Inventory and Monitoring Program detected bats on four of 15 survey nights (3 surveys in April, 1 survey in May) feeding in the National Park and harbor. The length and timing of survey used in the DEIS to detect seasonal, highly mobile rare species is inadequate.

The DEIS states (page 35 & Appendix E, page 10) that it is possible that the endangered, endemic Hawaiian petrel and the threatened Newell's shearwater fly over the project area between May and November. Yet properly timed surveys utilizing appropriate methodology for high-flying birds were not conducted to confirm flyover. Visual and aural surveys are not likely to be adequate to detect these species. Therefore the DEIS does not adequately assess the potential impacts to these protected species.

Section 3.7.2.2 Fauna, Anticipated Impacts and Recommended Mitigations

The DEIS states (page 36) "*Therefore, it is not expected that the development of the proposed Kona Kai Ola property will have significant impacts on native avian or mammalian resources present within the North Kona District.*" This statement is false and illustrates the lack of attention paid to all areas potentially affected by the proposed project activities, and the Cumulative Impacts section of the document (see comments on Section 8). Kaloko-Honokohau NHP is adjacent to the project site and contains significant foraging and breeding habitat for the Hawaiian stilt (*Himantopus mexicanus knudseni*) and the Hawaiian coot (*Fulica alai*) (USFWS 1999, page 33). Introduced predators are described in the Draft Revised Recovery Plan for Hawaiian Waterbirds, Second Revision (USFWS 1999, page 25) as having a negative impact on waterbird populations. Site grading the project's 530 acres will remove vegetative and structural cover that provides habitat for alien predators (feral cats, mongoose, feral dogs, and rats). Most of these predators will move into the National Park lands, increasing predator pressure on the endangered water bird populations. The NPS has observed this large-scale immigration of predators following the extensive grading of ~400 acres at the neighboring Shores at Kohanaiki development. This direct and cumulative impact and its mitigation is not addressed in the DEIS.

The DEIS proposes providing additional habitat for endangered waterbirds (page 36). On site predator control must be a significant consideration in this proposal for the reasons stated above. Furthermore, consultation with the US Fish and Wildlife Service and DLNR Department of Forestry and Wildlife is not mentioned and is required as part of this proposal.

Executive Summary, page vii and Section 10, Unresolved Issues
Groundwater
The source of water supply for the proposed project, 2.6 million gallons per day (Mgal/d), must be identified to be able to adequately assess project impacts to groundwater supply, flow to coast, and proximal environment. If local groundwater sources are tapped to meet the project demands, the DEIS is insufficient to address impacts. Oki et al. (1999) showed that groundwater flux to the coast along Kaloko-Honokohau NHP has decreased by ~50% and water levels throughout the National Park have dropped by ~0.6 ft since 1978 in response to modest levels of withdrawal. The demand for this project requires much higher withdrawal levels. Saltwater intrusion into the local aquifers would be an irreversible, significant long-term adverse impact to the local ecosystem and future groundwater use.

Section 3.8.1.2 Groundwater Flow and Quality
The DEIS states "*groundwater discharge occurs within a 20-foot thick layer just below the water table…*" (page 39). However, the fact that the DEIS also states that groundwater with a "*salinity of 34 ppt (97 percent seawater) is found at a depth of 80 feet*" (page 39), indicates that a component of fresh groundwater can still be found at a depth of at least 80 feet. Thus, a component of terrestrial-derived groundwater is discharging at a depth of at least 80 feet and not just within a 20-foot layer as stated. The DEIS also states: "*Numerical modeling of the groundwater flow system quantified the overall recharge and discharge of groundwater throughout the shoreline, but did not have sufficient details for the Honokohau area (Oki, USGS 1999)*" This statement is misleading. The authors of the DEIS are aware of the **Oki et al. 1999** report titled "Ground-water resources in Kaloko-Honokohau National Historical Park, Island of Hawaii, and numerical simulation of the effects of ground-water withdrawals," which specifically addresses the Honokohau area.

Section 3.8.1.3 Groundwater Flow and Quality, Anticipated Impacts and Recommended Mitigations; and Appendix F, Geology and Ground-Water Hydrology in the Vicinity of Honokohau Harbor
The DEIS does not provide the necessary data to describe or assess the environmental impacts to regional groundwater and to Kaloko-Honokohau National Historical Park, whose cultural and natural resources are dependent on groundwater quantity and quality. Groundwater flow and quality are not sufficiently quantitatively studied in the document, therefore conclusions regarding groundwater in the DEIS are scientifically unsupported.

The DEIS states (Page 40): "*…because the proposed marina is to the south and does not extend as far inland as the existing harbor, any impacts to groundwater flow will likely be limited to lands south of the existing harbor.*" No quantitative analysis of groundwater flow is provided in the DEIS to substantiate this conclusion. Furthermore, because groundwater can flow beneath the existing harbor bottom (see comment above re: page 39, terrestrial-derived groundwater is found at 80 feet depth), the excavation of the proposed harbor expansion can potentially affect groundwater flow to the north.

There is confusion in the DEIS on groundwater flow and quantity. Page 45 (Section 3.9.1.3) states that "*the proposed marina basin to the south will intercept additional groundwater, adding these* *flows to the existing harbor outflow.*" However, paragraph 3 on page 45 contradicts the previous statement: "*Hydrogeological studies have concluded that the expansion of the marina does not increase the groundwater flux through the harbor mouth into the ocean significantly. The groundwater from the brackish aquifer already converges to the existing harbor and does not show flow across the planned marina basin area into the ocean.*"

The figure of groundwater flow (Appendix F, page 6) indicates that development of the new harbor facility may intercept groundwater presently flowing to the sea perpendicular to the groundwater elevation contours presented and increase groundwater flow through the harbor and its entrance to the sea. The depiction of groundwater flow directions in this figure are based on instantaneous measurements and also presume that the groundwater-level contours are accurate based on data from only six wells. Data should have been collected from other wells to refine the contours. Given the effects of ocean tides on water levels, average water levels over a specified time period would have provided a better picture of average conditions than instantaneous measurements.

Given the uncertainty in groundwater-flow directions, it is possible that contaminants originating in parts of the proposed development can enter the groundwater system and flow to fishponds and anchialine pools in the National Park. To properly address impacts, a refined analysis of groundwater flow directions is needed but not presented in the DEIS.

There is no mention in the DEIS of the subsurface geologic conditions in the vicinity of the proposed project, which likely includes lava tubes that transmit groundwater toward the coast. Marina construction may change groundwater flow patterns in the vicinity, which can lead to changes in saltwater intrusion as well as changes in groundwater and nutrient flux to the nearshore environment. It is possible that well #6 may not currently be within the effluent plume from the WWTP and that creating the new basin could lead to elevated nutrient concentrations (relative to what was found in well #6) in groundwater discharging to the harbor. Unfortunately, water quality data from the other borings are not presented. The DEIS does not adequately address these issues to evaluate important possible impacts to water resources and to the nearshore ecosystem.

Although Appendix F (page 12) concludes that the "*Honokohau Harbor is the dominant drainage point with the groundwater flowing from the lands of the Kaloko-Honokohau National Park and from the vicinity of the Queen Ka`ahumanu Highway,*" no quantitative analysis of the effects of the harbor expansion on groundwater flow through the National Park is provided. If it is true that groundwater originating in the Park discharges to the existing harbor, expansion of the harbor may increase the likelihood for groundwater originating in the Park to discharge to the harbor area rather than continue to flow to coastal fishponds and anchialine pools in the Park. These ecosystems are dependent upon groundwater flow and quality. The DEIS dose not contain the necessary analyses to assess this impact, to quantify the change in groundwater flow to the Park's fishponds and anchialine pools, and to determine how salinity of groundwater in the Park might be affected.

The contention that the high tidal efficiency in well #6 indicates "*that there would be very little change if the rock were absent*" (Appendix F, page 10) is insufficient because (1) the existing rock must offer some resistance to flow, and (2) the geometry of the groundwater system will be altered by excavation of the harbor. Furthermore, no tidal data are provided to support the statement that the "*the tidal efficiency is nearly 100%*" (Appendix F, page 10) in well #6.

Water temperature values for monitoring wells (table on page14, Appendix F) range from 30.5 to 34.2°C. These temperatures appear high and are not consistent with values indicated on pages 11-12 of Appendix F.

Appendix F refers to well #2, well #2A, and well #6. Why are water levels or water-quality data from other wells that were drilled as part of the proposed development not presented (Section 3.8.1, Figure M, page 38,)?

Section 3.8.2 Surface Water.

The DEIS does not adequately describe the environmental impacts from stormwater runoff to the marina and no innovative, sustainable ("green") stormwater best management practices or other measures to mitigate these impacts are provided in the proposed drainage system for the project (see comments on Section 4.10.5, Drainage and Storm Water Facilities). The DEIS claims (page 40) average rainfall on site is 13 inches a year. However, page 26 cites a NOAA 2006 source of average annual rainfall as 15-20 inches, which could not be located at the website cited. The Rainfall Atlas of Hawaii (Giambelluca et al. 1986, Appendix Figure A.66) provides the range (averaged over 30 years) as **19.6 to 29.5 inches a year**. Planning for retention of runoff during high rainfall events is critical. Surface water retention on site should take into account at the **minimum** a 10-year storm event. The meaning of "*complete retention*" (page 41) of the 1-year 24-hour rainfall runoff is unclear and misleading. It is uncertain as to whether complete retention is meant to imply that the runoff would never enter the ocean. It will certainly enter the groundwater through the drywells (simple holes in the ground with no cleansing abilities), which will ultimately enter the harbor and nearshore waters. Evaluation of "complete retention," its feasibility, and the procedures to obtain "*no run-off*," cannot be made with the information provided in the DEIS. In addition, the DEIS misleadingly implies that 3 inches of rain in 24 hours is insignificant (page 40), ignoring the importance of the rate of rainfall. For example, on February 1, 2007, more than 3 inches in 3 hours (4.37 inches of rainfall in 24-hr) fell in the project area, causing significant sheet-flow surface runoff to the harbor waters (NPS RAWS rainfall data, NPS staff observation).

This section lists "*brackish well water*" (page 40, par. 7) as a source for irrigation of planted areas, but no other mention or discussion of impacts from on-site wells to groundwater quantity and quality are discussed in the DEIS.

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Section 3.9 Marine Environment and Aquatic Ecosystems

Section 3.9.1.1 Existing Conditions, Nearshore Environment and Coastal Waters

On page 43 the DEIS states that "*Currently 3 to 4 mgd of brackish water with salinities of about 5 ppt flow through the existing harbor into the ocean.*" On page 45 it states that "*the salinity of the water that discharges from the brackish aquifer is … about 4.3 parts per thousand (ppt).*" However it also states in the following paragraph on page 45 that "*At present the depth averaged salinity of the water exiting the existing basin is about 33.5 ppt close to the marina entrance.*" (Surface water of 33.5 ppt is shown in Figure 4 in Appendix H and appears to be accurate). Not only are these statements conflicting (4.3 ppt v 5.0 ppt) but they are also unnecessarily confusing to the lay-reader, first suggesting that the salinity of the water exiting immediately into the ocean is very low, 5 ppt, and then stating that the water exiting the harbor into the ocean is 33.5 ppt. The DEIS does not explain without contradiction that at present the water exiting the harbor into the ocean is about 33.5 ppt.

Section 3.9.1.2. Methodologies and Studies, Nearshore Environment and Coastal Waters
The bathymetric data used for models and for general discussion about impacts lacks the resolution requisite for 'best possible' interpretations. Many processes (waves, vertical mixing, dispersion of nutrients) are strongly dependent on the depth and morphology of the nearshore zone. The lack of high-resolution bathymetric data in the DEIS affects the validity of many statements and findings (page 43, paragraph 6).

Section 3.9.1.2. Methodologies and Studies, Nearshore Environment and Coastal Waters (Appendix G: Water Quality and Marine Biological Baseline Studies and Impact Analysis)
There are several inconsistencies in Appendix G. Water quality measurements were collected over 3 days during a 12-day (not 14-day as reported) time period in April, 2006 (page 8). Locations in Figure 2 do not correspond with descriptions in text. Transect A is offshore of Kaloko Fishpond; Transect B is offshore of Aimakapa Fishpond. Figure 11 apparently also represents the transect locations inaccurately. For example, as drawn, transects B, C, D, and E; would end in less than 10 m of water vs. ~20 m as stated in report.

The water quality and marine biological baseline studies (Appendix G) are each unsatisfactory in their sampling design and sampling effort, and therefore lack the statistical power to meet the stated objective to " *quantitatively describe existing water quality and biological community conditions....* " The DEIS studies cannot a) reliably characterize present conditions and b) serve as the baseline study to reliably detect future changes in benthic habitat, fish populations, and water quality originating from the development.

Furthermore, the proposed development may have a negative impact on marine communities. Therefore the DEIS needs to explicitly state (a) what level of change would be considered 'normal' or 'acceptable' either relative to the existing condition or to an appropriate set of control sites; and (b) what minimum spatial scale of impact would be detectable based on the surveys in Appendix G.

<u>Coastal Benthic Biota</u>
Appendix G does not cite the recent benthic habitat mapping studies by the USGS, Gibbs et al., (in press). Although it is "in press," the DEIS authors were aware of the mapping and its availability.

Although the DEIS states that "*Coral communities within the Honokohau Bay and off the Kona Kai Ola site area generally typical of West Hawai'i reefs, with little evidence of anthropogenic impacts.*" (Appendix G, page 2; DEIS page 41) Diver/snorkeler/fishing related impacts to reefs, especially close to shore and around mooring buoys, were apparently not evaluated.

The DEIS states: "*Highest coral abundance was observed at locations immediately to the north and south of the Honokohau Harbor entrance channel. Coral cover at locations north and south of these were not statistically significantly different; however, reefs to the north of Honokohau Harbor in general showed higher coral cover than reefs to the south, primarily because the* *southern reefs are more exposed to strong surf and associated damage and scour.*" (Appendix G, page 2) We concur that coral cover is highest directly north and south of the harbor mouth (e.g. transects D and E), however, a relatively large area of low to very-low coral cover exists between these two transect locations, directly seaward of the entrance channel, and in water depths greater than 12 m. The causes of this degradation are unclear. Hypotheses include high bottom stresses associated with tidal currents, the passage of boats, or natural focusing of flow on and off the adjacent shallow platforms, increased sedimentation, and/or water quality differences, including variations in salinity, temperature, and/or water chemistry resulting from the existing harbor.

Appendix G, page 2, par. 4 states: "*Water depths **at the shoreline** are 3-5 m, or deeper.*" [emphasis added] This statement is incorrect, and is misleading as to the potential impacts to the surrounding benthic community. Over 800 km^2 (200 acres), or about 1/3 of the marine area of the National Park consists of shallow intertidal (0 m) to –5 m (Mean Low Low Water) depths. Noio Point and southward is the only area in the National Park where the water depth at the 'shoreline' immediately drops off to around –3 m (Based on lidar bathymetry and habitat mapping; Gibbs et. al *in press*).

Appendix G, page 2, par. 4 states: "*The discharge of brackish water from Honokohau Harbor also does not appear to have impacts coral in the immediate vicinity; in fact, coral abundance is greatest at the two transects located immediately north and south of the entrance channel.*" This statement is misleading and is not supported due to lack of transects across degraded zone off the harbor mouth.

Additionally, the DEIS does not include a discussion of potential impacts to other marine invertebrate communities (e.g. intertidal) and there is no discussion of potential impact to the octocoral, which is abundant in shallow water.

Appendix G, page 2, par. 6 states: "*... a pulse of sediment may be discharged when the berm is removed.*" It is unclear how much sediment is predicted and whether the proposed silt curtains are adequate for the amount. This sediment could be an adverse impact to the corals, especially the high coral cover areas immediately adjacent to the harbor. The DEIS does not explain how additional sediment would be controlled in subsequent marina build out phases (see comments on Section 1.6.4).

The Coastal Benthic Biota survey in Appendix G is insufficient in the following areas:

1. Transect placement is inappropriate. Benthic surveys were conducted at nine sites (3 depths per site), which are spread over approximately 4.5 miles of coastline, including points up to 2.2 miles north of the harbor mouth. However, the most severe nearshore impacts due to harbor construction would presumably occur at shallow sites north and south of the harbor mouth, around Noio Point, and in adjacent National Park waters. If the study is intended to meet its objective of serving as a quantitative baseline for detection of future impacts, then it is not adequate to detect impacts at this spatial scale and transects should have been concentrated in the areas most likely to be impacted. Additionally, the lack of transects in the harbor mouth area resulted in incomplete or erroneous conclusions regarding coral cover directly offshore of the harbor mouth (NPS data, Gibbs et al. (in press).

2. More than one control site, with more than one transect describing each depth habitat, was not included in the study. A single control is statistically inadequate. Should some natural or anthropogenic impact occur on the single control site's small area, the control is useless for the purposes of monitoring this project.

3. The study methodology does not state how transect locations were selected. If transects were not selected randomly, the results only characterize the transects and cannot be extrapolated to larger areas.

4. The number of transects per site and habitat are insufficient to establish the baseline conditions. With the existing sampling design for the DEIS, mean coral cover of 25.9% at transect H was not significantly different from 50.3% coral cover at transect D (Appendix G, page 43, Table 10). Ecologically, and in terms of any future impacts of development, 50.3% and 25.9% represent a substantial difference in coral cover. The sampling regime probably cannot distinguish those two because there is only one sample per depth at each site. Recent NPS studies to determine required number of transects to establish baseline showed that a minimum of 10 randomly selected, 10-m permanent photo-transects per depth habitat **within each site** are necessary to reliably characterize coral cover on the reefs in the National Park. Fewer transects result in unacceptably high standard error and the inability to reliably compare sites or to detect change in the reef over time. Coral cover variability recorded at shallow depths in Appendix G (mean 28.7 ± 13 SD) are almost identical to the coral cover found at similar depths used in the NPS study (mean 28.1 ± 13 SD, NPS data). In Appendix G, the variability was greater at the "mid" and "deep" depth zones. Therefore, it is reasonable to estimate that to establish a baseline for the proposed development, the study design should have included a minimum of 10 randomly selected, permanent transects per habitat per site (i.e., if 3 depth habitats are monitored, 30 transects should have been monitored at each site, more for higher variability as in the "mid" and "deep" zones).

5. This DEIS study also cannot be used as the basis for future monitoring, because it has little chance of detecting changes (i.e. the study has low "Power") in coral cover due to low numbers of transects. Using the Appendix G data for mid-depth transects, we constructed a model to calculate the power of the study at varying alpha levels, lengths of time, and changes in relative coral cover (Skalski 2005; Table 1 below). Results, using DEIS data show that there is only a 12.7% chance of detecting change in coral cover over a 5-yr period even if the relative coral cover changes by 50% ($\alpha = 0.05$). For example, if coral cover dropped from 50% to 25% in 5 years, this study only has a 12.7% chance of detecting that change. Over a 25-year period there is only a 23.9% chance in detecting a relative 50% change in coral cover.

Table 1: The ability to detect change (i.e. Power) in coral cover at mid depth transects using the harbor study design (N=9, one-tailed test). Because coral cover baseline data only occurred once, power estimates were made with best estimates of temporal variance and measurement error. Data for a second sampling period was created by reducing relative coral cover at each 10 m transect by 10%.

Relative Change in coral cover	Power to detect change at different levels across different time periods				
α=0.05	*5 yrs*	*10 yrs*	*15 yrs*	*20 yrs*	*25 yrs*
10%	0.071788	0.092361	0.103573	0.105068	0.106393
25%	0.10695	0.114864	0.121963	0.128586	0.136087
50%	0.126679	0.157546	0.184683	0.212068	0.238778
α=0.10					
10%	0.142944	0.183106	0.204981	0.20693	0.208636
25%	0.210878	0.220881	0.230014	0.238406	0.247967
50%	0.241249	0.278896	0.312129	0.344535	0.375515

Total coral cover can be recorded with low measurement error and undergoes little natural temporal variability compared with fish surveys or water quality parameters. Therefore, the marine "baseline" study has even less ability to detect change in fish communities and water quality than shown on Table 1.

Coastal Fish Communities

The fish survey program is insufficient. Because there is substantial natural variability in fish communities they can be difficult to adequately characterize. However, given that the proposed development will lead to increased fishing pressure and potentially cause habitat degradation, negative changes in the fish community are possible. Most of the points discussed in the section above (Coastal Benthic Biota) also apply to the fish study. In addition, this survey contains almost no information on current abundance of primary fishery targets such as jacks, parrotfish, and emperors (Table D1 and D2). Although 36 goatfish were counted on transects E south of the harbor mouth, NPS staff regularly observe several hundred goatfish at the harbor mouth. A single 25-m long transect could easily yield counts of anywhere between 0 and 300 goatfish depending on the exact location and timing of any survey. These criticisms are not unique to this DEIS study, but a single 25-m fish transect at each depth zone is little more than semi-quantitative listing of the most common species; hence scientifically and statistically inadequate for the purposes of the DEIS. Power analysis was not performed to examine the ability of the study to reliably establish a baseline and to detect change in fish species and biomass. If these are unrealistic considerations, the limitations of the fish surveys should have been acknowledged. Additionally no attempt was made to reference existing, extensive fish-assembly time series data available from the Hawaii DLNR Division of Aquatic Resources.

Water Quality

The water quality baseline study uses an inadequate sampling design and also does not constitute a true baseline, but merely a single, discrete snapshot in time. Numerous published studies throughout Hawaii, including more than one hundred thousand observations made in Kaloko-Honokohau NHP by the NPS and the US Geological Survey (USGS), show that water quality parameters vary significantly through time. Thus, the temporally limited sampling scheme used in this study does not approach the need for accurate characterization of the water quality in or around the National Park and does not come close to approximating an adequate baseline.

The DEIS states that "*...guidelines established by the West Hawaii Coastal Monitoring Task Force were followed in water sampling and analysis procedures (WHCMTF 1992).*" (Page 43). According to a 2006 review of coastal monitoring data for developments in West Hawaii contracted by the County of Hawaii (Wiegner et al. 2006), these 1992 guidelines are outdated and "need to be revised, amplified, [and] enhanced..."

The methodology for collecting the near-bed samples was not detailed and thus it is not clear how representative the samples are for a given cross-shore location and water depth (Appendix G, page 8). The stated methodology is conflicting and lacks adequate detail. Table 1 states Niskin bottles were used, which are appropriate, however text states in several places (Appendix G, page 8) that water samples were collected directly into polyethelene bottles. It is well known that suspended particulate matter is under-sampled by collecting them directly into bottles due to turbulence induced by hydrodynamic friction at the mouth of the bottle (this is why Niskin bottles are used); the concentrations presented in the report likely do not accurately characterize those in the National Park and surrounding waters.

The report does not describe tidal conditions during the sampling periods for anchialine pools and marine waters, and is vague about strength of wind/surf condition (Appendix G, page 13). Thus it is unclear what conditions these measurements may characterize. Past work in the National Park has shown that groundwater effluence is typically greater at low tides and vertical mixing is greater during strong winds.

It is likely that potential high variability and relatively low number of samples may cause the power to be too low for 3-way ANOVA results to be reliable. Low statistical power means that the study design lacks the ability to reliably detect differences between sites or change over time.

The results presented in Appendix G suggest that groundwater is lower in salinity and higher in nutrients that oceanic waters. Because the harbor expansion will concentrate groundwater discharge into the new marina (i.e., Figure 10), this additional discharge will increase the amount (load) of nutrients in waters discharging from the harbor entrance. Appendix G states that "*Currently, brackish water discharged from harbor mouth generally flows NW, along the coastline fronting Kaloko-Honokohau Park. After construction of the new marina, brackish water flows along the Park coastline will increase*" (Appendix G, page 2). This direction of water flow is not revealed in the DEIS, only in the Appendix G. The effect of higher nutrient **loads** in Park waters are not addressed by the DEIS. This elevated load must be thoroughly assessed to determine both direct and indirect impacts to coastal marine resources.

Therefore, application of the Appendix G data in the DEIS for ecological baseline characterization, detection of change, or as a basis for future monitoring falls far short of adequate and is inappropriate and misleading.

Section 3.9.1.3 Anticipated impacts and Recommended Mitigation, Nearshore Environment and Coastal Waters

The DEIS states: "*Although the total amount of nutrients that will be generated per day will increase from the nutrient output of marine animals and users, the concentration of the nutrients will be lower due to the large amount of water available for mixing within the basin. The overall impact will be a reduction of nutrient concentration in the outflowing water.*" (page 44, par. 4) This statement is highly misleading. The impact must be evaluated in terms of the increase in **total nutrient load** discharged to the coastal ecosystem over time. In addition, the fate of this water will likely be quite different than that of the brackish groundwater discharge that occurs today. No consideration has been given in the DEIS to the flux, pathways, or impacts on the benthos, demersal, or vertebrate biota from an increased nutrient load. Furthermore, this discharge will enter Class AA waters. HAR §11-54-03(c) (1) states, in part, "It is the objective of Class AA waters that these waters remain in their natural pristine state as nearly as possible with an **absolute minimum of pollution or alteration of water quality from any human-caused source or actions.** [emphasis added] To the extent practicable, the wilderness character of these areas shall be protected." Although the project proposes to dilute nutrient concentrations, it will, in reality, significantly **increase nutrient loads** due to the input of the proposed 75 Mgal/d of pumped seawater, input from marine animals and users, and inputs from surface water runoff to the marina and groundwater carrying nonpoint source nutrients and pollutants. Therefore, as a result of this development, water quality will be significantly altered by human caused actions in contradiction to HAR §11-54-03(c) (1).

The total flux of nutrients (velocity times concentration) through the harbor mouth will increase as discharge through the harbor is increased by nearly two orders of magnitude (4 Mgal/d now to the proposed 79 Mgal/d), thus exposing the National Park and surrounding waters to a greater total nutrient load. Because of its greater salinity than the fresh groundwater discharge, it will be denser and will not be confined to the upper 3-4 feet as stated in the DEIS (page 46). Furthermore, because of the huge increase in total discharge through the harbor entrance, potentially greater mixing of the nutrient-rich groundwater down to the depths of the benthic ecosystems is highly likely to occur. Elevated nutrients can lead to irreversible impacts on benthic communities such as coral death and invasive algae growth as is presently occurring in Maui County (Smith et al. 2005). This long-term adverse impact is not discussed as a possibility in the DEIS.

We find no evidence to support the related statement, repeated several times throughout the DEIS, that large quantities of seawater pumped from the sea and discharged through the lagoons and water features will "*result in extreme dilution of the groundwater entering the marina with nutrient loading that is lower than the present coastal waters. Water quality will be improved, thereby generating a positive impact on the nearshore marine environment.*" (Executive Summary, pg. iii, par. 4, and page 44) This statement is contradictory to prevalent scientific information and logic. Today, low salinity groundwater mostly flows buoyantly at the surface to offshore areas where it is advected by surface currents and diluted by seawater across an area extending 1-2 km offshore. In the existing harbor, this fresh-brackish water lens can extend to at least 1-3 m in thickness. Depending on the tide level, it can interact with bottom biological communities. The surface groundwater-rich layer is periodically mixed to depths of at least 15 m under high wave energy (USGS Data). With the addition of 75 mgd of highly saline (36 ppt) deep seawater, the dynamics of groundwater discharge through the harbor and into the coastal ocean will certainly change. The thin buoyant structure of present day groundwater flow will likely breakdown and, because of salinity increases due to mixing with additional deep seawater, very likely will descend deeper in the water column as it moves offshore. Thus, the **nutrient loads** to deeper regions of the coastal coral reef ecosystem will very likely increase, thereby degrading the water quality and not improving it as claimed. The DEIS provides no evidence to suggest this scenario will not occur.

The DEIS states: "*There will be an expanded zone of mixing between the brackish effluent and the surrounding ocean water due to the concentration of flows at the harbor mouth*" (page 45). The waters immediately outside the harbor mouth are designated as Class AA, pristine waters. Hawaii water quality standards (HAR §11-54-3 (c) (1)) further state: "No zones of mixing shall be permitted in this class: (A) Within a defined reef area, in waters of a depth less than 18 meters (ten fathoms);" We could find no data or evidence in the DEIS, or in Appendix H, to support a claim that the entire effluent of the 75 Mgal/d input is mixed within the harbor basin. The new marina opening is positioned such that mixing with the waters of the current harbor basin will occur almost immediately adjacent to the harbor/ocean interface. As pointed out in the DEIS and previously in these comments, high percent cover coral reef is in less than 18 m of water, adjacent to the harbor mouth.

The DEIS claims that "*the intake water for the* [lagoon] *features has* ***low*** *levels of nutrients (185 ug/l TDN* [Total Dissolved Nitrogen] *and 5.6 ug of TDP* [Total Dissolved Phosphorus]" [emphasis added] (page 44). No citation is provided for these data and we could not find the source of these values for waters pumped from 100-300 feet depth in the DEIS or Appendices. The NEHLA does not have an intake pipe at the 100-300 foot depth so it appears no local, long term data are available for nutrients at this depth zone. However NELHA surface-water data for average TDN values collected at 33', 69' and 79' depths between May 2005 and March 2006 range from 57 to 65 ug/l, increasing with depth (NELHA analytical lab data). Because nutrient concentrations are expected to increase with depth, 185 ug/l TDN is not unreasonable. **However, it must be noted that it is nearly three times the concentration of TDN in the surface water. Therefore the addition of this water (75 mgd) will increase the total nutrient load to the harbor discharge.** Furthermore, Appendix G states (page 53) that "*Water from this depth* [100-300'] *is typically low in dissolved nutrients, with concentrations often below the limits of analytical detection.*" Yet the 185 ug/l TDN cited for this depth is well **above** the limit of analytical detection for this parameter. Additionally, the marine water quality standard for Total Dissolved Nitrogen for the Kona (west) coast of Hawaii Island [HAR 11-54-06(d)] is 100 ug/l. Adequate sampling at the intake depth to confirm the range of nutrient concentrations was not conducted and the impacts of additional nutrient load are not assessed in the DEIS.

We agree that there will be an interception and concentration of **new** groundwater flow to the harbor entrance (page 45, par. 1), however, the DEIS immediately, and incorrectly, contradicts this statement in the sentence following it. Most importantly, the DEIS does not adequately describe the fate and impact of this additional groundwater flow within the nearshore area.

The DEIS states: "*The large amount of water will dilute any pollutants that enter the harbor basin from groundwater or surface water. This will improve the water quality and be a positive impact on the nearshore environment.*" (page 45, par. 1) The preceding statement claiming that water quality will improve does not fully consider the large-scale increase in nonpoint source loads of toxins and pollutants from fertilizers, pesticides, volatile organic compounds, petroleum products,

trash, heavy metals, treated wastewater for irrigation, etc., that will be carried in surface water originating from the massive land-based scale of this development. The development, which includes commercial and industrial parks, large hotel and condominium buildings, parking lots, roadways, waterways and injection wells, will concentrate polluted runoff to groundwater and the marina. The document inappropriately exhibits its bias and lack of required objectivity (HAR §11-200-14) on page 40, stating that the project site will "***probably** cause an increase in runoff volume*" [emphasis added]. The DEIS states that the lagoon will have a plastic lining to protect the water features from stormwater runoff (page 100). However, the lower elevation of the water feature will cause it to act as a drainage receptacle for surface runoff and will concentrate the pollutants discharged into the marina basin. (See additional discussion in Section 4.10.10)
The 45-acre marina itself will be a significant source of many of these pollutants (some listed on page 46), however impacts of microbiological contaminants potentially introduced to the lagoons and waterways and holding pools from animals and humans are not considered, nor are the potential impacts of microbiological contaminants on human health or the affected ecosystems. Monitoring is not discussed in the DEIS. It is not stated if or how the water feature discharge points would be closely monitored for water quality. Nor is it clear if the water feature discharge points would require an NPDES permit. These nonpoint source and point source pollution issues are either ignored or given cursory mention in the DEIS, and no details for monitoring, or enforceable solutions are analyzed or offered by this "green" developer. Pages 46 and 47 do indicate some Best Management Practices for decreasing some of these problems, however it should be noted that the present harbor has difficulty enforcing these BMPs. Discussion of prevention, management, and enforcement throughout the lifespan of the development is missing from the document.

The DEIS states: "*The average outflow from the harbor will increase from 4 mgd to 79 mgd. The salinity of the water will change from an average of 33.5 ppt to about 34.4 ppt. The water will still be less dense, and the depth of impact will be limited to the surface 3 to 4 feet. The benthic flora and fauna will face a smaller variation in salinity that will discourage opportunistic biota dominance and lead to a healthier and more diverse benthic community. This is a positive impact on the benthic environment.*" (page 46, par. 1) As already stated above, these conclusions are scientifically unsupported in the DEIS. Furthermore, Hawaii water quality standards, state the following for basic water quality criteria applicable to all waters [including Class A harbors]: "<u>All waters shall be free of substances attributable to domestic, industrial, or other controllable sources of pollutants, including ... (5) Substances or conditions or combinations thereof in concentrations which produce undesirable aquatic life;</u>" [HAR §11-54-4 (a)] It is possible that the significant changes resulting from the various aspects of the water features may create conditions that are beneficial to pathogens or alien invasive species. The DEIS does not address these possibilities, or suggest mitigation for them. Increases in vessel traffic are expected with the proposed marina expansion. Vessels with larger ranges are known transport sources and mechanisms contributing to the further spread of marine alien and invasive species in Hawaii. The potential for introduction of alien marine species was pointed out to Oceanit in the NPS response to the EIS preparation notice (Appendix A). The DEIS does not respond to comments regarding the serious issue of alien species as required by HAR 11-200-15 (D), though the response letter from Oceanit said the issue would be addressed. The State of Hawaii has an aquatic invasive species management plan (DAR 2003), which is not considered or referenced in the DEIS).

The DEIS states: "*The increase in the outflow will cause a very slight increase in water velocities*" (page 46, par. 1). The DEIS does not estimate or comment on the increase in surface current velocities and related potential navigation hazards within the harbor mouth owing to a 3-fold increase in tidal prism and additional outflow associated with 52,000 gal/min (75 Mgal/d) for the proposed water features. A simple calculation shows that the average rate of 52,000 gal/min discharge into the proposed water features and harbor would increase the depth averaged current velocities at the harbor mouth by 1.0 to 1.3 cm/sec. A 3-fold increase in tidal prism (volume added to new expanded area) would also notably increase these velocities but is not mentioned in the DEIS. These increased current velocities may be compounded by surface flows during ebb tides and during water level set-up and set-down within the harbor associated with long-period swell. Increased current velocities may be significant for human-powered activities (e.g., canoes) and smaller power craft when exiting or entering the harbor. Furthermore, the increased tidal prism will likely increase mixing, bringing more of the nutrient-rich groundwater down closer to the seafloor, potentially negatively impacting the benthic ecosystems. Additionally, it will likely increase the zone of mixing laterally, potentially delivering higher nutrient loads to a greater area of the National Park's and surrounding waters.

Changes to current velocities and directions in nearshore waters, and potential significant impacts from the additional 75 Mgal/d exiting the harbor at a "*rate of pumping designed to achieve rapid turnover of water*" (page 44), are not discussed in the DEIS. Secondary impacts to fish and coral recruitment, and other related physical and biological processes due to changes in current velocities and direction are also not considered. Existing research on these topics in the National Park and surrounding waters was not considered in the DEIS. Potential impacts to local benthic habitat at the pipeline installation sites are also not discussed.

<u>Water Clarity</u>
The DEIS does not address the impact of the proposed harbor expansion and associated development on water quality and clarity of the existing harbor or nearshore waters. At present, water clarity is maintained by an "upwelling" circulation system maintained by offshore flow of buoyant groundwater that reaches at least 1-3 m in thickness. This circulation system and the present water clarity are likely to be compromised by changing the circulation dynamics due to tidal flow changes within the proposed expanded harbor. The DEIS does not address this topic to evaluate the impact on circulation and water clarity within the existing harbor. Nor is there any discussion on the potential short and long term impacts to water clarity (turbidity) outside the harbor resulting from the addition of 75 Mgal/d to harbor outflow. HAR § 11-54-04 (a), Basic water quality criteria applicable to **all waters**, states "<u>All waters shall be free of substances attributable to domestic, industrial, or other controllable sources of pollutants, including: ... (3) substances... in amounts sufficient to produce objectionable color, turbidity, or other conditions in the receiving waters</u>." The DEIS does not consider these potential long-term adverse impacts to coastal water quality.

In addition to direct ecosystem impacts from reduced water clarity (e.g., Rogers 1990, Richmond 1993, impacts to water clarity can negatively affect the local economy. Fifteen (15) day-use mooring buoys are located within the immediate vicinity of the existing harbor mouth and are heavily used by local scuba diving and snorkel charter businesses. The dive/snorkel industry is a significant component of the state economy, particularly in West Hawaii. Throughout the state, Hawaii's nearshore reefs annually generate about $800 million in gross revenue (Davidson et al. 2003). However the costs of degradation are significant. For example, more than $20 million per year is lost in Kihei, Maui alone due to impacts of algal blooms (Davidson et al. 2003). Currently, the state of West Hawaii's reefs is good (e.g., Waddell 2005). However, a current University of Hawaii study contracted by the County of Hawaii (Wiegner et al. 2006) analyzed available long-term water quality data for coastal developments in West Hawaii and suggests that "conditions in West Hawaii may be developing for extreme environmental degradation, possibly resulting in algal blooms like those in West Maui" (Wiegner et al. 2006, page 5). Ecosystem and economic impacts to water clarity resulting from the proposed project are not examined in the DEIS.

Appendix H. Zone of Mixing Report

In May, 2006, the National Park Service and the US Geological Survey were contacted by coastal engineers at Moffett and Nichol, who had been contracted by Jacoby Development, to model circulation and water column properties in the harbor and the adjacent coastal waters. Moffett and Nichol's engineers requested in situ instrument data from the USGS to provide boundary condition and calibration information for the three-dimensional numerical model. This advanced mixing models was not incorporated in this DEIS and its exclusion brings into question the reliability of the modeling results and impact assessment.

There is insufficient data on nearshore oceanographic processes. The oceanographic measurements reported in the Appendix H mixing study were made during May when precipitation and submarine groundwater (and thus brackish harbor water) discharge are low. Therefore, the meteorologic and oceanographic forcing, and the resulting flow and water column properties measured at the harbor mouth during the sampling period are different from times of high submarine groundwater discharge (page 2). Thus, the temporally-limited data collection efforts reported in Appendix H in May 2006, do not accurately or adequately characterize flow and groundwater (and thus brackish harbor water) discharge throughout the year. Furthermore, the results presented in Appendix H do not represent extreme outflow conditions as stated (page 1).

The May 10-12, 2006 measurements were not collected at spring high tide, as stated in the report (page 2), but rather the transition between the spring and neap tides. Thus the results presented in the DEIS do not, as stated, represent extreme outflow conditions (page 1).

Without information on the location of the ADCP (page 2), the harbor cross-section (page 4), and the CTD sampling stations (page 5), it is impossible to put the results in the necessary contexts of the appropriate geologic (bathymetric steering) and oceanographic (shear, eddies, etc) setting. This lack of information makes it difficult to determine if the conclusions drawn from these measurements are valid.

No information on the depth that the drifters' were drogued to is presented (page 2). Because the surface layer's thickness is spatially and temporally variable, it is unclear on what water mass the drifters were tracking and thus how the data supports the results presented. Drifter direction and velocity could simply reflect wind forcing alone, and potentially not be indicative of water movements.

No ADCP velocity data is shown, only directional information. Because the flux of a property is a function of the concentration of the property times the water velocity (magnitude and direction), the results stated on page 3 cannot be validated.

The report states that eddies are likely shed by the walls of the harbor channel (page 4), and thedirectional data presented in the DEIS show incredibly high directional spread, yet all of the calculations are based on one ADCP velocity profile and one CTD profile (page 7). The data presented in the DEIS suggest that the event used for the calculations is temporally limited and thus does not characterize the nature of water flow and the flux of brackish water out of the harbor entrance. As such, the data are inadequate to verify statements in the DEIS.

Because the proposed harbor expansion will increase the tidal prism by more than three times, the current velocities measured at the harbor entrance and the resulting flux of brackish water out of the proposed harbor will be much greater than that out of the existing harbor. This increase is not addressed at all in this report. Furthermore, the greater volumes of water moving in and out of the proposed expanded harbor and greater current velocities will result in two important impacts also not addressed in Appendix H or the DEIS. First, this increase will cause greater vertical mixing; bringing more of the high-nutrient brackish water (see discussion of Section 3.9.1.3 above) closer to the seafloor, which increases the possibility of negative impacts to benthic communities. Second, the larger outflow prism may cause the zone of mixing to be expanded spatially, potentially delivering higher nutrient loads to a greater area of the National Park and surrounding waters. (See comments on Section 4.8.2 for resulting navigation safety impacts.)

Appendix I. Wave Penetration Study

The input bathymetry is not of sufficient resolution for high-level models, as it is based on the older NOAA data rather than new, available LIDAR bathymetry data collected in 2000. (US Army Corps of Engineers; http://shoals.sam.usace.army.mil/hawaii/pages/hawaii_Big_Island.htm). The coarse resolution of the bathymetry used missed a number of known bathymetric features that could significantly modify the wave modeling results.

There were no *in situ* data collected, or at least reported, to verify the model results; thus there is no way to evaluate the accuracy of the modeling results (pages 3-6), which is necessary for impact analysis.

Section 3.9.3.1 Anchialine Ponds, Existing Conditions

HAR §11-200-12 (B) 9. states "...an action shall be determined to have a significant effect on the environment if it: ... 9. Substantially affects a **rare**, [emphasis added] threatened, or endangered species or its habitat." The DEIS confirms that anchialine pools and their rare endemic flora and fauna will be substantially affected by their total destruction.

The DEIS states (page 48) "*Ponds in the southern complex are moderately to heavily impacted, with many containing fish that exclude the anchialine crustaceans.*" This statement is inaccurate and misleading. An accurate portrayal of the southern complex pools is that some are moderately to heavily impacted, but others are in near pristine condition with no bottom sediment and water residence times likely short enough to mitigate the presence of high nutrient concentrations. A few pools concurrently contain both the endemic shrimp species (including the rare *Metabetaus* *loehena*, a candidate endangered species) and alien fish (NPS observation, USGS unpublished data), though only one such pool is listed in Appendix G Table 7. The NPS also questions Table 7 in the reported numbers of the common endemic shrimp (opae`ula) *Halocardinia rubra* found in the pools.

In 2002 the US Geological Survey–Biological Resource Division surveyed approximately 25 pools south of Honokohau Harbor within the legislated boundary of the National Park (note: pool numbers herein are "approximate" because of the interconnectedness of some pools at high tides). The survey was specifically designed to detect *M. loehena* (whereas the DEIS survey was not). Approximately 15 pools contained *M. lohena*, with 6 pools having average pool densities exceeding 100 *M. lohena* individuals. Almost all of the pools also contained alien guppies and/or mosquito fish. *H. rubra* were not quantitatively sampled in the survey. *M. lohena* was found to be particularly numerous at the eastern end of the complex (USGS unpublished data).

At the conclusion of this section the DEIS states: "*These factors* [elevated nutrients concentrations] *indicate that if no restoration or maintenance activities are instituted to reserve these ponds, these ecosystems will degrade beyond recovery.*" This sentence appears to make the oft heard argument in development documents that the resource is in such bad shape, or will be eventually, that there will be no significant loss or impact from destroying it. The same argument is repeated on page 51, par. 1, ending with the assertion that "*Even without the potential impacts from the proposed marina construction, the pond ecology might change irreversibly from the nutrient input, human indifference and expansion of non-native fauna species.*" This statement and others like it in the document are deliberately misleading to the readers unfamiliar with the site and pools in its portrayal of the condition of the pools. The loss of these pools and their rare endemic inhabitants (two of which are candidate endangered species) is indeed significant and irreversible. Anchialine pools are an important cultural and natural resource that is being lost island-wide to development. The pools on this site in particular have **national significance** and were specifically described in the nomination form designating the Honokohau Settlement National Historic Landmark. (See NPS letter Appendix A). Preservation of these unique and nationally significant resources is of paramount importance. The DEIS did not include an alternative that protects these features from harm.

Section 3.9.3.2 Anchialine Pond, Anticipated Impacts and Recommended Mitigations
The DEIS claims that anchialine pools to the north (in the National Park) are "*not likely to be impacted.*" This statement demonstrates vagueness resulting from incomplete groundwater studies (see discussion on Section 3.8.1), a lack of knowledge of the source of the project's required 2.6 Mgal/d of freshwater and associated impacts, and a lack of sensitivity to the protection of a cultural and natural resource that is vital to the mission of the NPS. Potential impacts to the pools in the National Park on the northern side of the harbor must be assessed through appropriate, more detailed groundwater studies and additional information on the source of water for the project.

The conclusion (page 51) that the candidate endangered orangeblack Hawaiian damselfly, *Megalagrion xanthomelas*, is not present on site due to "*the impacts from high nutrient input and general degradation of the ponds*" is unsupported. *M. xanthomelas* was not observed during the three survey days most likely because the survey method used was inappropriately designed to detect this candidate endangered species in terms of methodology and effort (including seasonal timing, diurnal timing, and effort-hours). Appendix G contains no survey methodology for surveying for the damselfly. The USGS surveys in 2002 established the presence of this candidate species (USGS unpublished data). The current study is insufficient to claim the species is no longer on site and the reasons for its "absence." These findings indicate that the project must include consultation with the U.S. Fish and Wildlife Service and the DLNR Division of Aquatic Resources to ensure candidate endangered species are protected.

DEIS suggests establishing a buffer zone for the newly created marine ponds as mitigation for the destruction of anchialine pools (page 51). However, marine ponds and anchialine pools are not the same cultural or natural resource, therefore the buffer is not mitigation for the anchialine pools that are destroyed. In terms of anchialine pool protection, no purpose is served by buffering an artificially created marine pond. Further, the DEIS proposes "*to move as much of the existing population of <u>Metabetaeus</u> <u>lohena</u> from these anchialine ponds before they become too saline, to possible newly excavated ponds that may be developed off-site.*" It is unclear where these newly excavated ponds are to be located. The environmental impact of the creation of new pools is not addressed nor is consultation with the USFWS. Finally, the suggestion that "*Public education on the unique ecology of the anchialine ponds and the need for preserving their ecology will reduce future human impacts in other healthy ponds*" (page 51) appears out-of-place in a project that will result in significant impact to the ecology of rare anchialine pools and their endemic flora and fauna.

Section 3.9.4 Marine Fishing Impacts
The proposed marina expansion will increase fishing pressure on the blue marlin as well as other fish stocks. Although the DEIS does not adequately examine other important Kona fisheries such as ahi and ono, the data provided in Section 3.9.4.1 and in Appendix Q indicate that the local blue marlin population is decreasing. Furthermore, there is evidence that Kona is a breeding ground for blue marlin (Appendix Q, page 6), and therefore increased fishing pressure will have a significant long term adverse impact on these local fish stocks and, as a result, the fishery. However Section 3.9.4.2 downplays the negative impact to the local marlin population and fishery by stating that "*It is not likely that the fishing pressure from the expanded charter fleet will have an adverse impact on the **Pacific-wide fishery***" [emphasis added] (page 52). The proposed promotion of "Slot Limits" (page 53) is a good idea and can be enforced in tournaments. However, the operators of the proposed marina will have no authority to issue or enforce these regulations for the charter fishery outside of tournaments. While there is merit in recommending educational programs "promoting" conservation management, education alone will not solve or mitigate the issue of over fishing.

Section 3.9.5.1 Marine Mammals and Sea Turtles, Existing Conditions
<u>Humpback Whales</u>
Humpback whales are commonly sighted in park waters and immediately offshore of the National Park water boundary. This occurrence is not mentioned in the DEIS.

<u>Dolphins</u>
The DEIS provides no study or literature review on the Hawaiian spinner dolphin (*Stenella longirostris*), or other small cetaceans similarly exposed to vessel traffic, tourism, construction, and degraded water quality, to assess potential impacts from these concerns on this protected

species. The DEIS does not state that spinner dolphins are protected under the Marine Mammal Protection Act (16 USC 1361 et seq.) and that "take" (i.e. harass, hunt, capture or kill or attempt to do so) [16 USC 1362(13)] is unlawful. "The term "harassment" means any act of pursuit, torment, or annoyance which—
(i) has the potential to injure a marine mammal or marine mammal stock in the wild; or
(ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering." [16 USC 1362(18)]. Consultation with NOAA regarding potential impacts to marine mammals is not mentioned in the DEIS.

The DEIS claims the dolphins "*at times **intentionally** congregate near the harbor channel to **take advantage by bow-riding outgoing vessels***" [emphasis added] (page 54, par. 3). This statement is grossly misleading. Although dolphins do bow-ride on vessels in the channel, the authors of the DEIS are also aware (NPS and others have provided the information) of data and studies describing the harbor channel as a known and primary spinner dolphin "resting area," i.e., an area close to shore routinely used during the day to rest, care for young, and avoid predators before traveling to deeper waters to forage throughout the night (Norris et al. 1994, Ostman-Lind et al. 2004). These areas are considered important to the health of the spinner dolphin population (e.g., Norris and Dohl 1980, Norris et al. 1994, Ostman-Lind et al. 2004). The DEIS states (page 54) that spinner dolphins rest in Honokohau Bay (which is a large area), but does not reveal the location of the resting area and misleadingly implies that the sole biological reason for the dolphins congregating at this site (the outer harbor channel) is to bow-ride. Spinner dolphin resting areas, in protected bays and coves in the main Hawaiian Islands, are well documented (Norris and Dohl 1980, Norris et al. 1994, Ostman-Lind et al. 2004). Spinner dolphins generally have a core area in each resting location where they spend most of their time while in rest (Dr. Jan Ostman-Lind, Kailua Kona, pers. comm.; unpublished data). In Honokohau Bay, which is one of only six primary resting areas on the Kona coast (Ostman-Lind et al. 2004), the resting area is located between the harbor mouth and the green buoy, and includes the boat channel and areas south of the channel (Ostman-Lind, pers. comm.; unpublished data).

Potential impacts to Hawaiian spinner dolphins from the proposed action are not discussed in Section 3.9.5.2 Anticipated Impacts and Recommended Mitigation. However on (page 54, par. 5) the DEIS states: "*Given the sporting habit of spinners and other dolphins of bow-riding ships and small boat wakes, they are apparently not overtly impacted by vessel traffic noises*." The assertion in this statement is also grossly misleading and unsupported by the recent scientific literature (e.g., Bejder et al. 2006a, 2006b). A significant increase in boat traffic and dolphin-watching tourism is also very likely to have a significant negative impact on this species as has been documented for bottlenose dolphins in Australia and New Zealand (e.g., Constantine et al. 2003, Hastie et al. 2003, Bejder et al. 2006a, 2006b, Lusseau 2003a, 2005). These studies document effects from small boats on marine mammals. The initiation of a jet-ski rental business would also have a significant negative impact on this species.

The volume of boat traffic passing directly through the preferred resting area is also likely to be an important factor in impacting resting spinner dolphins. If the volume of vessel traffic were to triple or quadruple, it is likely that the higher noise level could interfere with communication in addition to interrupting rest. It is a possibility, unexamined in the DEIS, that the dolphins cannot tolerate additional traffic volume at this site. It is possible that the present amount of traffic may already be near the upper tolerance limit for the dolphins because increases in vessel traffic likely decreases the time of rest for these animals (e.g., Constantine et al. 2003), which in turn may have adverse energy budget and life history consequences (e.g., Lusseau 2003b). No study has been performed or presented in the DEIS to assess the current condition, and understand and evaluate the future impacts of traffic, tourism, and construction on dolphins in this primary resting area.

Hawaiian Monk Seal

The DEIS erroneously dismisses the Hawaiian monk seal as an animal that is not likely to be impacted by the project activities. No data on the occurrence of Hawaiian monk seals in the area are presented in the DEIS. Monk seals do haul-out in the National Park, and it can be inferred that they are swimming in Honokohau Bay where they would be exposed to construction noise and increased boat traffic. Between 2003 and 2006 a total of 13 monk seal sightings (counted by calendar-day, i.e. an individual seal is counted only once per day even if it was sighted several times in the day) were reported in the National Park (NOAA Protected Species Division data). It is important to recognize that these reported sightings by the general public and NPS staff are **not systematic**, that is, there is no dedicated regular survey effort in the National Park to locate monk seals and that these sighting do not represent the overall use by seals of the Honokohau Bay shoreline. Appendix Q, Underwater Noise Impacts (page 7), proposes a visual look-out to detect seals out to a quarter mile during construction, which will be less than effective. The statement that "*monk seals are air breathing and spend the majority of their time above water where they are easily observed*" (page 54) is incorrect and misleading. When seals are at sea, they are difficult to detect because they spend most of their time submerged. Detection of seals at the surface is also very difficult because of their low profile.

Turtles

Green sea turtles (*Chelonia mydas*) and hawksbill sea turtles (*Eretmochelys imbricata*) are present in National Park and surrounding waters, adjacent to the project site. Hawksbill turtles are critically endangered in Hawaii, however a few identifiable individuals are known to frequent certain turtle "cleaning stations" and dive sites in either side of the harbor channel. (NPS data, L. Choquette pers. comm., K. Laros pers. Comm.). The DEIS does not discuss the presence of the hawksbill sea turtle at the site or potential impacts to this species.

West Hawaii subpopulations of green turtles are currently free of the so called "Green Turtle Fibropapillomatosis Disease" (Murakawa et al. 2000). Since 1999 the NPS has worked cooperatively with the NOAA Fisheries Marine Turtle Research program (MTRP) to monitor the health of the juvenile green sea turtle population in the National Park. Data on health, demographics, abundance, behavior, movements on the coral reef, sources of anthropogenic impacts, strandings, and degree of "residency" have been collected. One hundred eighty six individuals have been tagged with microchips, and the recapture rate of these turtles is greater than 70%. The National Park is an important feeding and resting habitat for resident juvenile green turtles on the West Coast of Hawaii (NOAA MTRP data, NPS data). The subpopulation of green turtles in the National Park consists of juveniles with strong site fidelity and can be considered "resident" (MTRP data, NPS data). Therefore, local adverse impacts occurring as a result of the proposed project, e.g., exposure to several years of construction noise, to increased amount of vessels and vessel noise, to greater levels of pollutants, trash, and degraded water quality, to increased fishing interactions/entanglements, potential increases in boat strikes, and significantly greater exposure to harassment from a concentration of tourists at the shoreline will likely affect most of the turtles repeatedly. These impacts will be significant, negative, and long term. Only a few of these impacts are assessed in the DEIS.

The DEIS erroneously cites only three turtle strandings within a radius of 10 miles of Honokohau Harbor since 1982 (page 55, par. 3). The three erroneous "strandings" cited in the DEIS are actually the subset of strandings that are unquestionably attributable to boat strikes (George Balazs pers. comm.). The authors inaccurately reinterpreted the number of reported boat strikes within 10 miles provided by Balazs to the total number of reported stranding. Since 2000, the NPS has responded to turtle strandings inside the National Park for NOAA Fisheries. Between 2000 and 2006, 20 strandings were recorded from the harbor (1 turtle) and inside National Park boundaries (19 turtles). One turtle with a severe propeller strike injury in the National Park survived and was not included in the three strikes provided by Balazs (two outside of the Park, one inside). Additionally, boat strike was implicated, but not definitive, in another of the 20 strandings (NOAA necropsy data). Six of the 20 strandings were a result of entanglement in fishing gear and 11 additional turtles have been freed of entanglements during the same time period (NOAA MTRP and NPS data). It is important to note here that the recorded number of strandings and entanglements does not reflect the true number occurrences within the National Park, the harbor, or within 10 miles of the harbor, nor do the number of boat strikes to turtles for the following reasons: 1) there is no daily systematic survey along the West Hawaii coast for stranded turtles; encounters are opportunistic, and 2) boat strikes are potentially more likely to go unrecorded due to the nature of the injury combined with the anatomy of turtles (lungs are positioned immediately under the carapace, i.e., the turtle's back. Therefore fatalities from boat strikes are likely to sink). Boat strikes and entanglements are significant adverse impacts to marine turtles and the risk will increase proportionately to the size of the marina as a result of increased number fishers and of vessels transiting the areas where turtles are regularly found. The statements and conclusions in Section 3.9.5.2 (page 56) regarding "*no documentation of adverse impacts*" to turtles inside the harbor and the "*very low*" potential for impacts to turtles from boat strikes and fishing is based on inaccurate information and are therefore unfounded.

Section 3.9.5.2 Marine Mammals and Sea Turtles, Anticipated Impacts and Recommended Mitigation; & Appendix Q, Underwater Noise Impacts Review

The impact of low frequency noise on marine fauna is falsely understated. Ample evidence exists in the literature that small boat noise does have an impact on the marine environment (e.g., Smith et al. 2004a, 2004b, 2006; Scholik and Yan 2002a, 2002b, 2002c; Samuel et al. 2005, Suzuki et al. 1980, Popper 2004) and such studies were not discussed in the text of the DEIS. Some of these papers are referenced in Appendix Q, but with little or no meaningful discussion.

The DEIS states that sea turtles "*abandoned their offshore (30-100 ft depth) resting habitats and concentrated in very near shore waters adjacent to the harbor [under construction] ... and, at times, even within the active construction areas as soon as blasting and excavation began*" (page 56, par. 1). An examination of the source of this statement in Appendix Q Underwater Noise (page 2) reveals that the statement does not cite a scientific study or the consultant's reports for the harbors under construction, but instead cites "personal communication" from consultants working on the construction projects. Because no supporting documentation or existing data were cited, it cannot be verified from the DEIS if the stated actions of the turtles were (1) determined by studies with statistically appropriate methodologies specifically designed to detect responses of marine turtles during construction, or (2) a few turtles (number unknown) were casually observed. It can be assumed if a scientifically appropriate study or data existed, it would have been cited. Therefore the statement above in the DEIS is potentially misleading and must be considered unsupported by scientific data, as are the broad conclusions that harbor construction does not negatively impact sea turtles.

The proposed mitigation for increased boat strikes, extending the no-wake zone, is appropriate, however as noted elsewhere for mitigation proposed by this DEIS, there is no discussion of how enforcement will be accomplished in the long term. Without enforcement capability, there is effectively no mitigation.

The DEIS offers no estimated values of sound frequencies and sound pressure levels anticipated as a result of blasting and pile driving construction activities. No estimate of the number of days these sounds can be expected in the air an underwater environment is made, (though it can be assumed that the 45-acre basin could take more than a year). Furthermore, no details are provided for review on a visual or an acoustic monitoring program, that will "*adjust construction activities*" (page 57, par. 1) when marine animals are present. The DEIS offers no information on the on the methodology for animal detection, i.e., criteria for minimum animal-distance to alter construction activity, and what construction activities would be altered. This proposed mitigation does not take into account that spinner dolphins are primarily silent during resting (Norris et al. 1994), that sea turtles do not produce sounds, and that monk seals do not vocalize underwater. Appendix Q proposes a visual look-out (not mentioned in the DEIS) but does not state how animals that spend the majority of their time submerged (hawksbill turtles, green turtles, monk seals) would be detected. The DEIS lacks details for this monitoring and mitigation activity, and does not propose monitoring that would be effective at detecting marine mammals and turtles. Alternatives for mitigation to reduce construction sounds are not considered in the DEIS.

HAR §11-200-19 requires that information in an EIS be presented in an easily understood manner and that data presented should be commensurate with the importance of the impact. Undue cross-referencing should not be needed. Section 3.9.5.2 and the review in Appendix Q in particular are incompletely researched and presented. Samuel et al. (2005) is in the reference list in Appendix Q Marine Fisheries Study, but not in the Appendix Q Underwater Noise Impacts list (where it belongs), and is never cited in text in either Appendix (both confusingly titled "Q"). The Samuel et al. study examines an important potential adverse impact, effects of boat noise on marine turtles. The findings of the study are not discussed and the topic itself is barely touched on in the DEIS text or the Underwater Noise Appendix. Nine papers are listed in Appendix Q but not discussed or referenced anywhere in the text. Appendix Q also incorrectly asserts (page 6) that "*Green sea turtles are on the EPA* [sic] *protected species list* ***due to their resemblance*** *to Hawksbill turtles which are on the endangered species list.*" [emphasis added]

Section 3.9.6 Ciguatera

Kaloko-Honokohau National Historical Park is a high cultural-use area for subsistence fishing. An outbreak of ciguatera as a result of the proposed project would affect traditional subsistence fishing, and pose a significant human health hazard. The Kona coast already leads the state in ciguatera poisoning (Gollop 1992, Ley 2002, Parsons *in press*). The ciguatera-causing dinoflagellate, *Gambierdiscus toxicus*, has been known to increase in concentrations after human or natural disturbances, including harbor construction (Randall 1958, Anderson & Lobel 1987). Thus, the project could cause a local outbreak of ciguatera in the National Park.

3.9.7 SWAC Facility

The DEIS provides almost no information about the SWAC system or about the disposal of the effluent water (7,500 gpm), which "*will be either directed to deep wells or to facilities where secondary use of this resource will occur.*" (page 59) However, elsewhere in the document (Appendix G page 3) it is stated this effluent will be piped to an offshore outflow that is at approximately 250 m deep. A proposed system of this magnitude, which has potentially significant impacts resulting from seawater withdrawal, the fate of the effluent, and the location, construction and operation of the pumping facilities (see comments Sections 4.4 and 4.10.10) must be detailed for public review in the DEIS. The potential impacts from each alternative: mariculture and its effluent disposal, injection back to the ocean, or injection to groundwater must be presented. For example, effects of injection to groundwater will depend on many factors, including the quality of the effluent, the final density of the effluent relative to the density of the groundwater near the injection depth, the rate of injection relative to the rate of ambient groundwater flow, the hydraulic properties of the rocks, and the extent of mixing. In terms of water levels, the injection could cause an increase in pressure in the groundwater system, possibly leading to a slight increase in water levels. The potential impact on water quality to the National Park's fishponds and anchialine pools is not examined.

Section 4 Assessment of Existing Human Environment

Section 4.1 Cultural Resources

The DEIS does not identify the Ala Kahakai National Historic Trail in the cultural resource section. The mission of the National Historic Trail is to preserve in place ancient and historic trails and routes. Page 63 of the DEIS mentions cartographic evidence of a shoreline trail route coming from Lanihau. Because this trail connected features contained in the cultural landscape, it should have been incorporated into the planning for a shoreline trail system. The preservation and management of pedestrian use of ancient and historic trails and routes were not incorporated into the development landscaping and pedestrian circulation plan. The loss of integrity of mauka-makai trails and lateral shoreline trails by not preserving them in place is a significant negative impact.

The preferred management alternative in the Draft Ala Kahakai NHT Comprehensive Management Plan/EIS, referred to as the "Ahupua'a Trail System," calls for the preservation of a system of trails that includes ancient and historic shoreline and near shoreline routes in order to incorporate features such as what is now referred to as the "Mamalahoa Trail" and mauka-makai trails. Destruction of trails is not consistent with the intentions stated and overtures presented in public by JDI to preserve the Hawaiian culture.

Section 4.1.2.1 Cultural Resources, Anticipated Impacts and Recommended Mitigation

The DEIS states that "*In interviews, one of the greatest areas of cultural concern was potential impacts to water quality as related to fishing grounds and ponds.*" (page 64) and that "*It is recommended that the cultural and archeological resources be protected… .*" The water quality of the anchialine pools will be destroyed. These anchialine pools are currently important sources of *opae `ula* gathered for traditional subsistence fishing, and historically important as water sources and other uses. Most have been modified by people and are also archeological features. The DEIS provides no evidence to support that water quality in the equally culturally important marine environment will be maintained with the current plan (see comments on section 3.9.1). No studies are provided or cited that show groundwater withdrawals will not affect water resources in the National Park (see comments on section 3.8.1). In the National Park, the water itself is a cultural resource; the dynamic thread that ties the cultural and natural environment together. Present day activities and cultural practices in the National Park, and in the proposed project area, rely on the quality of the water resources for those practices. The pools, the fishponds, the ocean waters continue to provide life to the people. To degrade them is a significant adverse long-term impact.

The two heiau within the proposed project area are ceremonial structures, therefore the views of the mountain and the entire viewshed are of utmost importance to traditional practices. In the cultural impact statement, Mr. Mahealani Pai talks about the cultural importance of the view of the mountain from the ocean. (Appendix K, page 25). It is not clear in the DEIS how makai to mauka viewsheds will be preserved by the proposed construction (e.g., 4-story hotels on 20-50 feet graded land, page 28) since no graphic visual impact analysis exists.

Section 4.2 Archaeological Resources

Section 4.2.1.2 DLNR and Parkway Corridor Site Findings

The DEIS does not mention the Ala Kahakai National Historic Trail or the National Historic Landmark designation that applies to a portion of the project site in this section. It also appears that no human-modified anchialine pools were included in the 432 listed archeological features. Most if not all of those pools were modified by humans and have been utilized for perhaps hundreds of years, as such they too are archaeological features and should have been included in the list of archaeological sites that will be destroyed by the proposed undertaking. No direct connection in the DEIS appears to be made between the cultural and natural aspects of the anchialine pools.

Page 68 of the DEIS states: *"The most significant (in length) trail segment is 7704 which is 428 feet long marked by 26 aligned cairns. This trail segment is located on the makai boundary of the wastewater treatment plant and extends in a north south direction but appears to be a partially constructed spur of another trail that was abandoned and not utilized."* Trail 7704 along with the trail identified in the Emerson 1880 Map (Site 50-10-27-21588) should be preserved and would compliment the "Ahupuaa Trail System" as it pertains to the mission of the Ala Kahakai. NHT (see Section 4.1 above).

According to the DEIS, no trails outside of the shoreline setback or buffer are to be preserved. More effort should have been placed on 1) locating and preserving Trail 21588 (see comments below on Appendix L), 2) preserving trail 7704, and 3) consultation with Ala Kahakai NHT on preservation and mitigation, especially since the project area derives its name from a trail or path. As explained in the DEIS (page. 62, par.1): "*The translation of Kealakehe is interpreted in two ways: 1) Kealakehe, with the emphasis on the last syllable, translates as "the pathway of graves"; 2) Kealake'e, with an 'okina replacing the "h," is the more popular definition, which means "winding path.*"

Section 4.2.2 Anticipated Impacts and Recommended Mitigations
Significant archeological sites and features within the project area are major features that honor the landscape, its history, and descendants. The DEIS states (page 69) that 29 of 182 (page 67) archaeological sites are recommended for preservation in accordance with a Site Preparation Plan and that 13 of these sites are within the Kaloko-Honokohau NHP legislated boundary (Appendix L states 25 will be preserved; page 229). However, Figure Q shows there are 19-22 sites within the legislative boundary recommended for preservation, and the number of sites to be preserved shown in Figure Q is 34. Fifty four known archeological sites are proposed for destruction, plus 47 are recommended for mitigation through data recovery, totaling 101 sites destroyed (however our count is 153; 182 sites minus 29 sites). These discrepancies are confusing and possibly misleading as to the actual number of sites to be destroyed. All sites within the NHL and the National Park boundary must be preserved. The mitigation proposed in the DEIS, data collection, is inadequate. The DEIS contains no other mitigation proposals.

Appendix L: Archeological Inventory Surveys 2006
Ala Kahakai National Historic Trail is not mentioned. The archaeological report does not fully acknowledge the presence of the National Historical Landmark (NHL), nor does it mention "Honokohau Settlement," (State site 50-10-27-4138). The National Park's legislative boundary is identical to the NHL boundary and should have been depicted on all such maps. When discussing preservation criteria it is important to know previous designations. The inclusion of sites within the NHL boundary is definitely a matter that should be discussed within the findings and individual site descriptions. All sites within a National Historical Landmark are considered contributing elements to the significance of the NHL as a whole.

Within the northeastern DLNR parcel that abuts Kaloko-Honokohau NHP and the DHHL parcel, a trail identified within the report and referred to as the trail on Emerson's 1880 map (page 12, par. 4, figure 5 and page 227, par. 5) was not located during the survey. This trail is well documented within the National Park as site 50-10-27-21588. A portion of the trail was destroyed in the development of Gentry's Marina boat yard. In 2002, an archeological survey was conducted by the National Park for a temporary sewer line through the State Highway easement between Queen Ka`ahumanu Highway and the DHHL parcel. During the NPS survey, the trail was located along with a well-defined causeway. The trail within the National Park and in the state highway easement is characterized as a single-file foot/hoof worn trail over pahoehoe. There are no kerbstones associated with this trail but it may have petroglyphs and cairns. With the thickness of the fountain grass and haole koa, relocation of the trail may not be easy; however, this lack of discovery does not mean that the trail is not present. Trail 21588 is an important cultural feature, as the DEIS states in the Cultural Impact Study (Appendix K): "*The need to revive mauka – makai trails was expressed, as well as the need to protect cultural and archaeological sites*" This trail was an important transportation route to and from Honokohau Settlement, and falls under the Highways Act of 1892, HRS Chapter 264-1(b). This trail should have been located and must be preserved.

Section 4.3 Visual Resources
The DEIS does not provide a visual impact analysis of vertical structures proposed for the site on surrounding view-planes, including from within the National Park. This type of analysis is critical for public review and comment. Visual impact analysis is common and could have been

accomplished with geographic information system software such as ARCMAP or AutoCAD Wire Frame Diagram for 3D display. No analysis was made or presented that takes into account the estimates of the proposed site grading heights (page 28) and height details of each building to reveal how each would be elevated above the current natural grade, or above a baseline of sea level. (see also comments in Section 3.4.4 and 4.1.2.1).

Section 4.3.2 Visual Resources, Anticipated Impacts and Recommended Mitigation
The DEIS states (page 72) that the proposed Harbormaster Control Tower "*will be visible from the ocean and the Kaloko-Honokohau National Historical Park.*" No impacts of this structure are assessed in the document. In addition to being visible from the National Park, the building will block emergency and other required vehicular access to the `Aiopio area in the National Park. No mention of potential impacts to the Ala Kahakai National Historic Trail is made. No alternatives to this structure are offered in the DEIS. For example, a reasonable, commonly used, and cost-effective alternative that was not examined is to install webcams in various locations at the harbor entrance. The DEIS fails to meet the requirement to include reasonable alternatives and mitigations.

Project lighting will also have a negative effect on visual resources and nightscape in the National Park. Light pollution of the night sky will interfere with visitor experience and evening traditional cultural practices. No impact analysis of light pollution, or its mitigation, to the National Park is made in the DEIS.

The "*400-foot buffer zone*" (page 72) is offered as a mitigation for visual resources. The buffer itself must be clearly defined as to exactly what will occur and what will be excluded within this buffer. The NPS requested this clarification in our response letter to the EIS preparation notice (Appendix A) however, contrary to requirements in HAR 11-200-15 (D), no meaningful response with specifics was given or incorporated into the DEIS.

The buffer zone has unexamined impacts of its own. It is unclear what is meant by "*cultural or environmental-related improvements*" and how they will be constructed and managed. Also "*culturally related structures*" is not defined. No discussion in the DEIS is presented on the following: whether amenities (light, restrooms) will be in the proposed buffer zone; if any of the proposed pumping activities for deep ocean water will cross the buffer (i.e., pipes and pumping station); if there will be any landscaping and/or grading activities within the buffer; what fertilizater and/or pesticide/herbicide use is proposed in this area; how the trail system will be constructed; if utilities trenching will be allowed and if so, trenching may impact archeological sites and features. No discussion exists of how public use at Alula Beach will be directed and regulated (i.e., if there will be lifeguard towers constructed, trash receptacles, recycling, etc). None of these potential impacts to resources in the buffer zone are addressed in the DEIS nor are mitigation measures offered.

Section 4.4.2 Noise, Anticipated Impacts and Recommended Mitigation
The DEIS states that project generated noise will not impact adjacent properties as they are "*mostly vacant or industrial*" (page 73). However, Kaloko-Honokohau National Historical Park is an adjacent neighbor and impacts to Park visitors and Hawaiian practitioners are not discussed.

Furthermore, resident and locally migratory (endangered) waterbirds, marine mammals and sea turtles will also be impacted by the noise and light generated by the project.

Natural soundscapes are an essential facet of the National Park experience. Visitors come to the Park to learn about the cultural and natural resources of the area, to experience, see and hear what the people of the Honokohau Settlement might have seen and heard during daily life in a Hawaiian community. Hawaiian practitioners come to practice their culture in an appropriate setting, unhindered. Some visitors come just to experience a "spirit of place," solitude, inspiration, and relaxation. A cultural live-in center, to be established in the Park, is a central component of the National Park's mission and will be affected by the unmitigated 11-15 years of construction noise and dust associated with this project.

Prolonged construction time (up to 15 years) will impact visitors driving on Kealakehe parkway to the Park (and may deter them), will impact visitors and practitioners in the Park and cultural live-in center, and will impact the quality of interpretive programs and the experience of visitors in the southern area of the National Park. These negative impacts are not considered in the DEIS. Construction noise occurring from development on the Park's northern boundary is already impacting Park programs and individual visitors. A 300% increase in vessels entering and exiting the harbor is an additional noise impact to visitors and practitioners on the shoreline that is not considered in the DEIS. Figure R illustrates that long term noise will be closest to the National Park.

No sound monitoring stations were established in the National Park to collect baseline data and analyze impacts. The DEIS does not include information and analysis concerning impacts from construction activities such as blasting, pile driving, and grading; impacts from a 300% increase in audible vessel traffic; and stationary sources such as the ocean water pumping equipment on Park visitors, cultural activities in the Park, interpretive and education programs in the Park, and sensitive resources including protected species.

Section 4.5.4.3 Project Compatibility with Existing and Emerging Community

The National Park (Ala Kahakai is not mentioned here, but should be) is incorrectly placed under the "*Short-Term Compatibility with Neighboring Uses*" section. In fact, the National Park Service is charged with protecting Kaloko-Honokohau in perpetuity, that is, "to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations (16 USC 1). Significant long-term adverse impacts and reasons for long term incompatibility between the National Park and a development of this magnitude are discussed in detail multiple times elsewhere in these comments. The long-term section does not discuss potential long term environmental or cultural consequences in any context. The no action alternative should be addressed here as well as throughout each section of the document.

The DEIS states that one of the long term compatibilities of the project is its "*Marine Orientation*" implying an "*active interaction with the ocean*" (page 81), yet no study has been conducted for the DEIS to support this compatibility. The DEIS does not include a study on the carrying capacity of the coastal waters for scuba diving and snorkel tourism, whale and dolphin watching, or fishing charter boats, although it can be expected that these industries will grow with a triple-fold harbor increase. Another concern is that in the private marina there will be no state control over commercial businesses. A jet-ski, or personal watercraft, rental operation in the new marina would likely result in high use of these craft in Park waters. These craft and their associated noise (both in air and underwater) are highly incompatible in the short and long-term with the mission and purpose of the National Park and the cultural land- and seascape, and are incompatible with the local populations of resting dolphins and marine turtles. This potential impact should be mitigated by disallowing such businesses in Honokohau Harbor. Furthermore, the increase in long-range yacht traffic may lead to the introduction of alien species. The west coast of Hawaii Island is one of the only coastlines in the Main Hawaiian Islands that has not been invaded by alien species, which have caused great ecological and economical loss elsewhere (Waddell 2005). The DEIS does not address these impacts or offer mitigation.

Section 4.8.2 Marina Traffic Study, Anticipated Impacts and Recommended Mitigation.
See comments on Section 3.9.1.3 regarding tidal prism and navigation hazards. This section assumes only one type of vessel using the harbor. No assessment is made of impacts to human powered craft (canoes, kayaks) from increased vessel traffic.

Section 4.7 Vehicular Traffic
As noted in the DEIS the existing traffic conditions are currently highly impacted and the project will further add congestion. Park visitors use these roads to access the Park and traffic contributes to their overall park experience. The Kealakehe Parkway intersection currently "*operates at AM and PM peak periods at LOS F*" (page 90). This is the worst level of service rated in traffic studies and it appears the project will increase the impacted situation: "*There are increased delays anticipated at all intersections during the AM and PM peak periods compared to delays expected without the project*" (page 92). In addition, the DEIS notes potential mitigations but provides no guarantee of implementation and does not include a property map to identify whether the mitigations are achievable within existing right-of-ways. Parking locations in the development are also not identified.

Section 4.9 Trails, Bike Paths and Pedestrian Access
The DEIS does not acknowledge that the Ala Kahakai NHT is intended for the preservation of ancient and historic trails, and routes for management and use by the public with landowner's consent. There may be modern connector trails that link ancient and historic trails and routes. The Ala Kahakai's purpose was not stated and differentiated from modern bike paths and sidewalks in the DEIS.

Section 4.10.5 Drainage and Storm Water Facilities
The DEIS states that "*The storm drainage facilities designed for the site will take advantage of the porosity of the existing rocky landscape and the minimal slope, through the use of grading and dry wells, per County requirements*" (page 100). The DEIS offers no further details on the site design of stormwater system, the discharge points for 10-yr and 100-yr stormwaters, or impacts to receiving water bodies. County and state stormwater requirements are not designed to protect ecosystems, only drinking water. The drywell system is no more than a hole in the ground and offers no additional protections to groundwater. No innovative sustainable or "green" solutions or BMPS are explored in the DEIS for stormwater runoff control and the removal of pollutants. No alternatives are given in the DEIS. For example the alternative of installing a stormwater line to the

wastewater treatment plant is not analyzed. (See related comments on sections 3.4 Natural Drainage and 3.8.2 Surface Water).

Section 4.10.6 Waste Water Facilities

The impacts and mitigation measures for wastewater are not complete. The DEIS makes no estimate or calculation of the increase in wastewater effluent that would be generated by the combination of uses of the final project at full capacity and does not evaluate whether the Kealakehe Waste Water Treatment Plant (WWTP) can accommodate the project in addition to those waiting to go on line now and in the future from projected development in the North Kona region. It is stated that the plant currently treats to R2 (secondary treatment) and could potentially have a 7.8 Mgal/d capacity (page 101), but no value for the requirements of the full project is stated. It is possible the project will nearly double the current 1.8 Mgal/d of wastewater received by the WWTP and put a strain on its 20-year design capacity of 5.3 Mgal/d. If the proposed development pumps its wastewater to the WWTP for treatment, it will significantly contribute to its own groundwater contamination by increasing the loading to the wastewater disposal sump. A suggested mitigation is to recycle R1 water on site, but the plant would need an upgrade and no discussion of upgrade is mentioned in this section. Page 122 suggests that upgrades to the plant will be required to bring it to R1 and possibly (but not stated) to increase the capacity, but it is not stated who will be required to fund the improvements, how the upgrades fit in to the project phasing, and if the Master Plan scheduling is considered in the project phasing. These details are not included and explained clearly in the DEIS. Although the use of recycled water for irrigation would save water (page 102), using treated sewage so close to the groundwater and marina would likely add to the nutrient load exiting the harbor mouth. These additional nutrients and their impacts are not addressed in the DEIS.

4.10.8 Potable Water Facilities

The source of water supply for the Kona Kai Ola project demand needs to be identified in the DEIS to be able to adequately assess project impacts to groundwater supply, flow to coast, and proximal environment. The DEIS indicates it will need to secure water quantities estimated at 2.6 million gallons per day (maximum daily demand). That is the residential design equivalent of serving 26,000 people per day (100 gpd/person) for all kitchen, laundry, bathing, sanitary, and other uses around the home, and also represents 7% of the 38 Mgal/d total estimated sustainable yield from the Keauhou aquifer. The likelihood of obtaining 2.6 Mgal/d without significant impact to the subsurface and possibly the marine characteristics is low. The DEIS also indicates the Department of Water Supply (DWS) sources are not adequate to support the project needs. A plan to secure water quantities for the proposed development is not complete. As a result, the impacts to the National Park and mitigation measures have not been adequately addressed in this DEIS.

4.10.10 Water Features and Lagoons

The DEIS fails to justify the need for the proposed lagoons, nor are there meaningful mitigation actions or any alternatives provided in this section. These water features will have significant adverse direct and indirect environmental impacts including construction noise and air quality impacts, using large amounts of building/lining materials, using large amounts (undisclosed) of energy to pump 75 mg from the ocean daily, and degrading the water quality in the nearshore area of the National Park. The water feature may divert the existing local marine tourism economy from guided snorkel and scuba diving tours, rather than expand it. The ocean fronting the proposed development contains ample turtles, rays, and sharks. Therefore it is unnecessary to remove these animals from their natural habitat to use as displays, especially when the high environmental and energy costs required for the creation of these lagoons is considered.

The project proposes to include shark, turtle and ray lagoons on site, (page 106) yet no federal permit is listed in Section 5.3 for captive protected species (turtles).

The DEIS states that "*This* [high volume of sea water flowing through the lagoons] *will improve the water quality and will be a positive impact on the nearshore marine environment.*" (page 106). The DEIS uses this statement misleadingly (see extensive comments on section 3.9.1.3) and does not reveal all impacts. Studies off shore of major developments on the west coast of Hawaii Island have shown an increase in nutrient concentrations (Wiegner et al 2006). Additional nutrient load will further degrade the nearshore water quality of West Hawaii.

The description of the drilling and placement of the pipes should include a detailed map that shows the proposed location of the pumping station for the SWAC and lagoon system as well as a bathymetric map outlining the location of the intake pipes. The potential impacts of the pumping stations, sea water intake, and piping system need to be included in the DEIS. Additionally, the noise impact study does not evaluate the noise impacts from the pumping station.

No cited references or data are presented to support the statement (page 107) that "*the water quality* [at 150-200' depth]… *is both high and relatively constant over the course of a year.*" (see comments on Section 3.9.1.3) In the discussion of temperature of the water for the lagoons, (page 107) it is stated that "*It is essential that the water be kept cool at all times" to prevent the growth of algae, parasites, and pathogens.*" However, such required cool water may not be attractive to the tourists for whom these features are created.

The DEIS incorrectly states (page 108, par. 3) that the outflow salinity will be "*about 33 ppt.*" According to page 46, par.1, the new outflow salinity will be 34.4 ppt, i.e., more dense (and will sink) from mixing with 75 Mgal/d of 36 ppt seawater.

The DEIS states that "*nutrient loading is lower than the present coastal waters*" (page 108, par. 3). This statement is incorrect and contradicts the correct statement in the paragraph immediately preceding it (page 108, par. 2) stating that "*the total amount* [i.e. load] *of nutrients that will be generated per day will increase.*" Moreover, at present the nutrients stay in the low-salinity upper layer. Slightly higher salinity and vertical mixing will make the constant high load of nutrients more available for benthic communities with resulting negative impacts. (see comments section 3.9.1.3).

Section 5 Conformance with Public Plans and Policies

The proposed Kona Kai Ola project does not comply with public plans and polices. An exhaustive discussion of each plan and policy is not included here as the significant points are made elsewhere in these comments. When necessary, specific contradictions to public plans and policies are discussed below. The DEIS does not comply with HAR §11-200-17(H) because it does not reveal any conflicts or inconsistencies, nor describe a reconciliation with the plan or policy.

Section 5.1.1 Chapter 343, Hawaii Revised Statutes
The DEIS does not comply with Chapter 343 HRS and Chapter 200 HAR because the DEIS, as written appears to be pre-decisional, does not adequately review all proposed project components (e.g., "required" proposed marina size) or activities (e.g., SWAC and drinking water sources), does not identify environmental impacts and their mitigation, does not evaluate any alternatives other than the preferred alternative, and does not adequately respond to comments received in the preparation of the statement. The document, as written, appears to "be a self-serving recitation of benefits and a rationalization of the proposed action" (HAE 11-200-14) in which potential impacts to the environment are downplayed throughout the report.

5.1.3 Coastal Zone Management Program, Chapter 205A, Hawaii Revised Statues
The proposed project does not appear to comply with the CZM recreational resource policy *B(i)* (page 112) to "Protect coastal resources uniquely suited for recreation activities that cannot be provided in other areas", nor does it comply with applicable portions of the Hawaii State Plan sections 226-11 (page 119) and 226-23 (page 125) or Hawaii County General Plan sections 2, 8, and 12 (pages 130,137,140). The nearshore areas adjacent to the Harbor mouth are rich with coastal resources including excellent dive sites, healthy coral reef, class AA coastal waters, important fish, dolphin, hawksbill, and green sea turtle habitat. These resources face irreversible adverse impacts under the proposed development. Furthermore, the DEIS did not complete a recreational analysis to examine current recreation patterns in the area and how these present uses will be impacted.

The proposed project also does not comply with the CZM historic resource policy *C* (page 112) to "support state goals for protection...of historic resources", nor does it comply with applicable portions of the Hawaii State Plan sections 226-12 (page 120) or Hawaii County General Plan sections 2, 6, and 14.7(c) (pages 130, 135, 143). The proposed development does not adequately protect historic resources. It appears that out of 182 sites (including 543 features) only 29 will be preserved (See section 4.2.2). The anchialine pools, endemic fauna, and native vegetation within this buffer "are an integral and functional part of Hawaii's ethnic and cultural heritage" (HSP 226-12) but will be irreversibly destroyed (see comments section 3.7.1.2 & 3.9.3.1).

The proposed project does not appear to align with the CZM scenic and open space resource objective to "protect, preserve ...or improve the quality of coastal scenic and open space resources" (Page 113), nor does it align with applicable portions of the Hawaii State Plan sections 226-12 (page 120) or Hawaii County General Plan sections 7, 8, and 14.8 (pages 136, 137, 144). Between the Queen Ka`ahumanu Highway and the shoreline, the development includes numerous 3 and 4 story structures on rock platforms that may be graded as high as 50 feet above natural elevations. Alternatives to the two-story Harbor Master Control Tower are not discussed (see comments section 3.3.4 & 4.3).

The proposed project does not comply with the CZM coastal ecosystem policies *C, D*, or *E* which act to "Protect valuable coastal resources, including reefs, from disruption and minimize adverse impacts on all coastal ecosystems" (pages 113-114), nor does it comply with applicable portions of the Hawaii State Plan sections 226-11 and 13 (pages 119, 121) or Hawaii County General Plan sections 2, 4, 7, and 8 (pages 130, 133, 136, 137). The faunal/floral habitats will be destroyed in all anchialine pools and all vegetation in the 400-foot buffer will be impacted. The nearshore areas reefs and coastal resources face irreversible adverse impacts under the proposed development (see comments on section 3.9).

The proposed project does not comply with the CZM economic uses policy *B,* which requires that developments are "located, designed and constructed to minimize social, visual, and environmental impacts on the coastal zone management area" (page 114), nor does it comply with applicable portions of the Hawaii State Plan sections 226-11, 12, 13, and 104 (pages 119, 120, 121, 126) or Hawaii County General Plan sections 2, 7, and 8 (pages 130, 136, 137). For example, the artificial lagoon feature proposed purely for aesthetic and revenue reasons, will take up approximately 19 acres, and has the potential to greatly adversely impact water quality, water flow, cultural and natural coastal resources, and natural reef communities near the harbor mouth (see comments on section 3.9 and 4.10.10). Additionally, the DEIS does not adequately justify the need for the proposed project at the full-scale preferred alternative (see section 1.4).

The proposed project does not comply with marine resource policies *A* and *B* aimed to "promote the protection, use, and development of marine and coastal resources to assure their sustainability" (page 116), nor does it comply with applicable portions of the Hawaii State Plan sections 226-11, 12, 13, and 104 (pages 119, 120, 121, 126) or Hawaii County General Plan sections 2, 4, and 8 (pages 130, 133, 137). Seawater exiting lagoons and marina will not improve water quality; rather these features will very likely greatly degrade present conditions. It is unclear how the development intends to "*improve fishery conservation*" when it is contributing to an increase in the size of the fishing fleet (see comments on section 3.9.4).

5.1.4 Hawaii State Plan, Chapter 226, Hawaii Revised Statutes
226-4 State Goals
The proposed project does not appear to align with Hawaii State goals of protecting the natural environment and fulfilling the needs and expectations of Hawaii's people. It does not "ensure that visitor industry activities are in keeping with the social, economic, and physical needs and aspirations of Hawaii's people." (HSP Section 226-8; page 118). According to Hawaii Tourism Authority's 2006 survey, 76% of Hawaii's residents agreed that "Even if more visitors come, I don't want to see any more hotels on this island." (Market Trends Pacific 2006). Many tourists presently visit the Honokohau area to enjoy Alula Bay, popular dive sites, birding, fishing, Kaloko-Honokohau National Historical Park and Ala Kahakai National Historic Trail among other activities. The proposed project may, in fact, degrade one of the key open space areas that draw tourists to Kona. In *A Visitors View of Paradise: A Report on Maui's Visitors... Why they come, What they enjoy, Why they return* (Sierra Club 1998), 91% of tourists randomly surveyed reported that preservation of natural areas was very important to their decision to return to visit and that they would like to see more "natural coastline." The proposed project will utilize enormous amounts of resources and energy, will place added stress on existing infrastructures, and will have irreversible adverse impacts on significant historical, cultural, and natural resources. Therefore it does not appear to be a "sustainable development" (see comments on Section 1.5.2).

5.2 County of Hawaii General Plan 14.7c
The Hawaii County General Plan 2005 for the DLNR portion of the development was amended from "Open" designation to "Urban Expansion Area" in 2006. The DEIS quotes the rational for the amendment: "*The state plans to expand the harbor and have* ***some associated commercial and***

golf course development surrounding the harbor" [emphasis added] (page 130). However, the proposed Kona Kai Ola project strongly diverges from this intended use and proposes to include three hotels, 1800+ timeshare units, and a ~19-acre water feature with significant long-term adverse impacts to nearshore waters. Under Section 25-5-160 of the Hawaii County Code, the project site remains "Open" zoning. County rezoning should not occur.

5.2.3 County Zoning

Under Section 25-5-160 of the Hawaii County Code, the project site is zoned "Open". The proposed time-share and hotel units and commercial uses would not be consistent with this zoning designation. Rezoning should not occur.

5.3 Permits Required for Project

Federal

U.S. Army Corps of Engineers Permit (Section 404)
U.S. Army Corps of Engineers Permit (Section 10)

Section 5.3 of the DEIS lists two Federal Permits that are required for the proposed project/undertaking. Federal Undertakings requiring National Environmental Policy Act (NEPA) and National Historic Preservation Act (NHPA) review are defined as:

> "(y) *Undertaking* means a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or on behalf of a Federal agency; those carried out with Federal financial assistance; and those requiring a Federal permit,[emphasis added] license or approval" [36 CFR PART 800 -- PROTECTION OF HISTORIC PROPERTIES (incorporating amendments effective August 5, 2004)].

When the U.S. Army Corps of Engineers considers permitting the proposed project, it will be required to evaluate the effects under both NEPA and NHPA including effects on historic properties and consultation with the Advisory Council on Historic Preservation.

> "Section 106 of the National Historic Preservation Act of 1966 (NHPA) requires Federal agencies to take into account the effects of their undertakings on historic properties, and afford the Advisory Council on Historic Preservation a reasonable opportunity to comment. The historic preservation review process mandated by Section 106 is outlined in regulations issued by ACHP. Revised regulations, "Protection of Historic Properties" (36 CFR Part 800), became effective January 11, 2001, and are summarized below" [36_CFR PART 800 -- PROTECTION OF HISTORIC PROPERTIES (incorporating amendments effective August 5, 2004)].

The Army Corps of Engineers must complete the NHPA Section 106 process before issuance of the Federal Permits.

> (c) *Timing*. The agency official must complete the section 106 process "prior to the approval of the expenditure of any Federal funds on the undertaking or prior to the issuance of any license [36 CFR PART 800 -- PROTECTION OF HISTORIC PROPERTIES (incorporating amendments effective August 5, 2004)].

Kona Kai Ola proponents including the State of Hawaii DLNR should be thoroughly familiar with NHPA Section requirements and realize that a State of Hawaii Environmental Impact Statement is not sufficient to proceed.

When the U.S. Army Corps of Engineers considers permitting the proposed project, it will also be required to evaluate the effects under the Endangered Species Act, requiring consultation with the USFWS and the NOAA-Fisheries.

Section 7 Relationship between Short Term Uses of the Environment and the Maintenance of Long Term Productivity
This section does not meet the requirements of HAR §11-200-17 (J), which states: "The discussion shall include the extent to which the proposed action forecloses future options, narrows the range of beneficial uses of the environment, or poses long-term risks to health or safety. In this context, short-term and long-term do not necessarily refer to any fixed time periods, but shall be viewed in terms of the environmentally significant consequences of the proposed action." The discussion in the DEIS does not adequately or realistically discuss any of these elements, including future actions foreclosed which involve the NHL and the National Park. The discussion in this section, as throughout DEIS, is entirely in a positive light rather than an impartial examination of the alternatives, impacts, and long and short-term gains and losses. Adverse impacts are treated superficially and downplayed. The statement that "*The natural environment, including the shoreline environment will be altered but its long term sustainability, viability and productivity will be enhanced.*" (page 153) is inaccurate, unfounded and unsupportable by the studies in the DEIS.

The statement that "*The infrastructure improvements to the site, primarily the upgrades and subsequent hookups to the wastewater treatment plant will result in less effluent seeping into groundwater/nearshore waters from the temporary sump used for disposal of the effluent from the waste water treatment plant, as well as input via the septic systems used at the existing marina.*" (page 153) is also unfounded and confusing. Because upgrades to the WWTP are not described in the document, other than to state they will be needed (page 122), it appears that, if the proposed development pumps its wastewater to the Kealakehe Wastewater Treatment Plant for treatment, it will significantly contribute to its own groundwater contamination by **increasing** the loading to the wastewater disposal sump.

Section 8 Cumulative Impacts
This section does not begin to adequately investigate and address the cumulative impacts of the proposed development as required by HAR §11-200-17(I). This section is an incomplete list of some of the development projects occurring in North Kona. Direct and indirect cumulative effects are not discussed for most of the resources affected by the proposed project as a result of cumulative actions. The C-17 SAAF construction at Keahole International Airport and increased daily military over-flights (flight paths including the harbor and nearshore area), the state highway expansion, the cultural live-in center at Kaloko-Honokohau NHP, the TSA industrial park expansion, the comprehensive management plan/EIS of the Ala Kahakai NHT, and the intention of the Shores at Kohanaiki development to significantly impact local groundwater resources by installing eight wells for coastal golf course irrigation, are a just few of the projects in the

immediate area that are not mentioned or considered. Cumulative impacts to noise levels (including underwater soundscape), viewscape, night sky pollution, endangered species, groundwater quantity and quality, anchialine pools, air quality, marine (natural and economic) resources, traffic, cultural and natural landscape, utilities infrastructure, etc., from the cumulative interactions of the projects listed above and others, are either not discussed or are only mentioned briefly. Past, present, and future conditions, projects, and their primary and secondary effects, positive and negative, are not described in the document for review so that the public may fully understand the cumulative impacts to resources by the addition to those of the proposed project. It is a critical component of the environmental review process that has been ignored in this DEIS.

Section 9 Probable Adverse Environmental Impacts Which Cannot be Avoided

The summary of unavoidable adverse impacts is incomplete, downplayed, and in some cases misleading. For example, the statement that "*Construction of the new marina will cause the removal of **some** anchialine ponds, as well as the change from brackish water to marine ecosystems in the **remaining** anchialine ponds makai of the new harbor*" [emphasis added] is used or similarly phrased throughout the document (pages iv, 51, 119, 154, 159) and gives the false impression that some, not all, of the anchialine pools will be destroyed. The reader must be reading carefully to understand that as a result of the proposed project, **all of the pools** (which have national significance, a fact that is omitted) will be destroyed. Most of the adverse environmental impacts that are unavoidable resulting from this proposed project are not listed for the following resources: groundwater, coastal marine ecosystem, candidate endangered species and their habitat, endangered species, protected species, cultural and archeological resources including the fragmentation of the existing cultural landscape, and night sky pollution. Resources that are listed are treated in cursory fashion. This section of the DEIS is wholly inadequate.

Section 10 Unresolved Issues

Both the water demand for the development (2.6 Mgal/d) and the SWAC system have potentially significant long-term, irreversible negative impacts on the groundwater flowing through the National Park. These impacts are too significant to leave unresolved and should have been included in the EIS.

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July 23, 2007

Geraldine K. Bell, Superintendent
U.S. Department of the Interior
National Park Service
Kaloko-Honokōhau National Historical Park
73-4786 Kanalani St., Suite 14
Kailua-Kona, Hawai'i 96740

Dear Ms. Bell:

Subject: Kona Kai Ola Draft Environmental Impact Statement
Response to Your Comments Dated February 6, 2007

Thank you for your comments on the Kona Kai Ola Draft Environmental Impact Statement. This letter responds to your comments. For clarity purposes, your comments are identified by page and paragraph number, and the text of your comment is provided.

Environmental Review
The DEIS does not satisfy the environmental review process under HRS 343 and HAR 11-200- 23 because it does not submit for review all proposed project components that may have significant impacts, does not disclose and describe all identifiable impacts, does not respond to comments submitted during the review process, and does not adequately explore mitigation measures. The document appears to merely be "a self-serving recitation of benefits and a rationalization of the proposed action" (HAR §11-200-14) in which impacts are downplayed throughout.

Response: We respectfully disagree with your generalized statement regarding the non-compliance of the DEIS with HRS 343 and HAR § 11-200-23. The Kona Kai Ola EIS identifies and assesses all identifiable impacts and fully discusses various mitigation measures. We have responded to all comments to the EISPN and the DEIS. Further, the EIS process for Kona Kai Ola does not downplay impact. The EIS includes a thorough evaluation of potential impacts of the proposed development.

Every effort was made to fully investigate issues raised in DEIS comments. Several additional studies were conducted to expand our understanding of existing conditions, identify project impacts and proposed appropriate mitigation measures. Additional studies conducted in response to DEIS comments included:

- An Inventory and Assessment of Anchialine Pools Including Management and Mitigation Recommendations
- Marina Harbor Water Quality Study
- Evidence and Implications of Saline Cold Groundwater
- Groundwater Effects on Anchialine Pools

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- Supplemental Groundwater Sampling and Analyses for Priority Pollutants
- Description of Marine Mammal and Sea Turtle Species
- Acoustic Analysis of Potential Impacts (related to construction-generated underwater acoustics)
- Ambient Noise Measurements and Estimation Study
- Workforce Housing Impacts Assessment

Alternatives
The DEIS asserts that only the full build alternative is feasible. This assertion defeats the purpose of environmental review, which is to give decision makers and the public the opportunity to consider environmental impacts of differing alternatives to achieve the purpose and need for the project. The State of Hawaii Guidebook for the Environmental Review Process states an Environmental Impact Statement "must present alternatives, methods, modes, or designs of the proposed action (Guidebook, page 21)."

The DEIS states: "Hence, the agreements and leases between the State and JDI indicate that the no-action alternative has been rejected at this time" (page ii). The assertion that the No Action alternative is infeasible suggests that the agencies may have been pre-decisional in eliminating alternatives prior to environmental analysis. The NPS has concerns because it appears agreements were concluded prior to required environmental review. As noted in the DEIS: "The agreements and leases between the State and JDI stipulate the parameters of development for this site in terms of uses, quantities and size of many features, resulting in a limited range of land uses" (page ii). What benefit is the environmental process if the decisions about development have already been made? In addition, the change in county zoning of part of the property from "Open" to "Urban Expansion Area" should not be made without the benefit of the environmental analysis.

Response: As explained in the DEIS, the agreement between JDI and the State of Hawai'i established a required scope and scale of the project for which the impact analysis was required and is now being provided. Several comments have addressed the fact that alternatives other than the No Project Alternative were not addressed in the DEIS Section 2, Alternatives Analysis.

We are of the position that alternative actions other than a No Project alternative are not currently feasible without an amendment to the agreement with the State. However, agency and public comments in response to the DEIS, as well as additional information generated as a result of inquiry into issues raised by the comments, have been helpful in identifying alternative actions that will serve the State's goal of providing additional marina slips for the Kona area. These alternative actions also serve to reduce or mitigate anticipated effects of the proposed development.

Thus, agencies such as the Land Division of the Department of Land and Natural Resources, the U.S. Department of the Interior Fish and Wildlife Service, the Planning Department of the County of Hawai'i, and the Office of Environmental Quality Control (OEQC), as well as community organizations have commented that a reduced scale marina and related facilities should be considered. The OEQC has also asked that the alternative of a reduced scale project be evaluated under the assumption that DHHL may determine that a downsized project would be preferred.

In response to these comments on the DEIS and in consideration of measures to mitigate anticipated impacts, the EIS Section 2, Alternatives Analysis, has been revised to describe the following alternatives, which are discussed in more detail in the EIS:

- Alternative 1 is a project involving a 400-slip marina, 400 hotel units, 1,100 time-share units, and commercial and support facilities. This alternative would enhance water quality and avoid the need to widen the existing harbor entrance channel, as well as reduce traffic and socioeconomic impacts.

- Alternative 2 is an alternative that had been previously discussed, but not included in the proposed project that includes an 800-slip harbor and a golf course.

- Alternative 3 is the no-action alternative.

A comparison between impacts related to the proposed project concept and impacts related to Alternative 1 indicates that a reduction in the acreage and number of slips in the marina, as well as the reduction in hotel and time-share units, would generate less environmental, traffic, social and economic impacts. Although positive economic impacts would be reduced, Alternative 1 can be considered as a preferable alternative because of reduced environmental impacts. However, while it can be concluded that the 25-acre marina in Alternative 1 would be the preferred size, the DLNR agreement establishes the size of the marina at 45 acres and 800 slips. An amendment to the DLNR agreement is required in order to allow Alternative 1 to proceed. Hence, selection of Alternative 1 is an unresolved issue at this time. The additional EIS text that includes the added EIS Section 2, Alternative Analysis, is contained in Attachment 1 of this letter.

Scientific Study
The DEIS contains a substantial number of statements that are not supported by scientific data or references to published literature, or cannot be verified because of lack of information on methodology in the Appendices. Many statements in the document are contradictory, often on the same page. Some studies in the DEIS, upon which conclusions regarding impacts and their significance are based, are wholly inadequate in statistical sampling design and effort, and use methodologies that are inappropriate to establish baseline conditions or to detect the presence of rare species. Application of information gathered in these inadequate studies results in conclusions that are unsupported and invalid. Where possible, we have identified these shortcomings in the Specific Comments below.

The bathymetric data used for models and for general discussion about impacts to the nearshore environment lacks the resolution requisite for 'best possible' interpretations. Many processes (waves, vertical mixing, dispersion of nutrients) are strongly dependent on the depth and morphology of the nearshore zone. The lack of high-resolution bathymetric data in the DEIS also affects the validity of some statements and findings.

<u>Response:</u> We are responding to your overall comment regarding the application of information, including scientific data, and related references as they appear in your comments. We note that the overall EIS, which includes the EIS draft and final reports and technical studies, represents a rigorous effort to derive findings and conclusions based on reliable data and sound methodologies.

Regarding your comment on the data used for models used to study the nearshore environment, the study models are appropriate. The bathymetric data used for the hydrodynamic and water quality modeling effort was created using data collected by the SHOALS (Scanning Hydrographic Operational Airborne Lidar Survey) system to a depth of 30 m. At the harbor the bathymetry was created using the available navigation chart.

Offshore areas were constructed from surveys collected by the National Oceanographic Service (NOS) of NOAA and available via their GEODAS system.

Hazards
There is little or no consideration given to the sporadic natural and anthropogenic events that can and will occur. Events include periods of extremely large waves, heavy rain and coastal run-off, oil/fuel spills in the harbor, and other similar events. Large waves from a tsunami or major storm will likely hit this part of the Kona coast at some point in time. The DEIS also lacks citation of key current reports regarding this topic, such as: Fletcher et al., 2002. Atlas of Natural Hazards in the Hawaiian Coastal Zone. Given that such events often are the processes that most affect both human safety and ecosystem health, critical analysis of the probability and outcome of such events should have been considered in the DEIS.

Response: We assume that this comment is in reference to the incorporation of these events in the hydrodynamic and water quality models. These models are intended to reproduce "typical" conditions. The available data were not sufficient to calibrate the model to specific conditions as are mentioned by NPS.

Water Resources
The source of water supply for the Kona Kai Ola project demand (MGal/day) must be identified and included in the DEIS in order to adequately assess project impacts to groundwater supply, flow to coast, and proximal environment. If local groundwater sources are tapped to meet the project demands, the DEIS is insufficient to address impacts. Saltwater intrusion into the local aquifers may affect future groundwater use and the local ecosystem. The DEIS does not provide the necessary quantitative data to describe or assess the environmental impacts to regional groundwater and to the National Park, whose cultural and natural resources are dependent on groundwater quantity, and quality. Therefore conclusions regarding groundwater in the DEIS such as "it is highly unlikely that existing groundwater flows to the Kaloko-Honokōhau pond system ... will be impacted by the proposed marina..." (page iii) are scientifically unsupported and ignore the cumulative impacts of groundwater withdrawal occurring in the local area.
The statement "...water quality will be improved, thereby generating a positive impact on the nearshore marine environment" (page iii), is repeated throughout the document and is misleading and unsupported by studies or data in the DEIS. The discharge of ocean water (75 Mgal/d) from the lagoon and water feature will have a significant negative impact on the nearshore environment because:

- *The added discharge is 20-fold higher than the current discharge, resulting in a net higher load of nutrients.*
- *There is a greater degree of vertical mixing with the addition of the more saline (dense) ocean water, making the nutrients more available for the benthic communities, which can lead to irreversible impacts on reef communities such as the invasive algae growth plaguing Maui County.*
- *There will be an additional increase in added pollutants and nutrients because the lagoons will act as a drainage receptacle for polluted stormwater runoff from road ways, landscaping, etc.*
- *There will be additional nutrient loading in the lagoons due to biological activity of captive animals.*

Although the DEIS claims that nutrient concentration flowing through the harbor will be reduced in by the addition of 75 Mgal/d of ocean water, the fact, that was not disclosed in the DEIS, is that the total load (Le., amount) of nutrients to the nearshore will be greater due to *the higher flow rates. The DEIS does not consider the flux, pathways, or impact on benthos of an increased nutrient load. We could not find scientific evidence in the DEIS that supports the claim that water quality in the nearshore waters will be improved by the addition of 75 Mgal/d ocean water.*

Response: As discussed on page 2 & 3 of this letter, several additional studies were conducted in response to DEIS comments and these studies contributed to the development of Alternative 1, which includes a smaller marina, less boat slips, and a reduction in marina size. The EIS has been revised to clarify the three studies conducted to evaluate impacts on nearshore and coastal waters, and the following is revised text in Section 3.9.1.2. Additional text is underlined, and deleted text is indicated by strike-through text.

> Three studies were conducted to evaluate project impacts on nearshore and coastal waters. Oceanit completed a Zone of Mixing study that was presented in the DEIS and is contained in Appendix I. This study was tasked with determining the mixing and dispersion of flows emerging from the harbor into the adjacent shallow nearshore waters. To accomplish this, data from previous studies were reviewed and field research was conducted to measure stratification and currents adjacent to the harbor entrance and out into the ocean. A "Zone of Mixing" area was determined outside of which there is no discernable influence to water quality from the existing harbor effluent. This information was used to assess impact from modifications to groundwater inflow from marina expansion, and the seawater effluent flow from the marine water features.
>
> A Wave Penetration Study was prepared by Moffatt and Nichol to determine wave characteristics within the existing harbor and the proposed expansion basin. This study was presented in the DEIS and is contained in Appendix J.

In response to DEIS comments, a Harbor Water Quality Modeling Study was prepared by Moffatt and Nichol and is presented in Appendix U of this EIS. The third study was based on a three-dimensional hydrodynamic and water quality model of Honokōhau Harbor and its surrounding waters, and the following is additional EIS text in Section 3.9.1.5 that describes the methodology:

> A three dimensional hydrodynamic and water quality model of Honokōhau Harbor and its surrounding waters was developed using the Delft3D modeling suite and is described in detail in Appendix U. The model was driven at its offshore boundaries by tidal predictions, and calibrated to reproduce available measurements of water levels, currents, salinity and temperature.
>
> Model results suggested that the brackish groundwater inflow to Honokōhau Harbor was approximately 30 million gallons per day (mgd), with an average salinity of 22 parts per thousand (ppt), in order to reproduce the salinity profiles observed from a number of available data sets. In addition, this flow rate is in very good agreement to the published values of brackish groundwater inflow to Honokōhau Harbor. The model also showed that under these conditions, Honokōhau Harbor maintained a flushing time of approximately 12 hours, which is consistent with available studies and data. The flushing within the harbor was found to be primarily due to the density currents that result from the salinity gradient within the Harbor created by the brackish groundwater inflow. This finding also corroborated with study findings that this flushing mechanism results in water exchange in the harbor on the order of seven times faster than if it were flushed via tidal action alone.
>
> A water quality model was developed to replicate typical conditions experienced in Honokōhau Harbor and its environs. Water quality parameters were calibrated and validated using two available datasets. It was found that the water quality within Honokōhau Harbor is primarily maintained due to the high rate of circulation. The

nutrient loads entering the harbor through the brackish groundwater inflow are high, and without high flushing, water quality within the Harbor would not be able to be maintained.

Attachment 2 contains the entire revised Section 3.91, Nearshore Environment and Coastal Waters. Attachment 2-A contains the Harbor Water Quality Study, which is referred to as Appendix U in this letter.

The following is a response to each topic in this comment:

- *The added discharge is 20-fold higher than the current discharge, resulting in a net higher load of nutrients.*

  Response: It is inaccurate to compare the new nutrient load as being "20 fold" higher as this represents a comparison between 75 mgd of purely saline water and 2 mgd of purely fresh water. These two numbers are not comparable, as the fresh water inflow is mixed into a brackish layer that is by volume significantly greater than 2 mgd. This is explained in Oki et al. (1999), and further clarified in Appendix G-1. The actual quantity of brackish water that flows into Honokōhau Harbor currently was calibrated to be approximately 30 mgd of 22 ppt water. This was also corroborated by observations by Gallagher (1980), which means that the net inflow is only three fold greater than what exists currently.

  Additionally, assuming that the quantity of water is three-fold does not indicate that total loads are higher. That load depends on what is being produced by the animals within the seawater lagoons in comparison to the total loads coming from the groundwater. According to calculations performed by ClowardH2O, the nutrient loads within the constructed exhibits total 15 kg nitrogen/day including the loadings of the ambient seawater. Using the values used as input parameters for the water quality model (Chapter 3 of Appendix U), it was found that the total daily loads from the groundwater into Honokōhau Harbor total about 50 kg of nitrogen and about 7 kg of phosphorous. Thus the mass impact from the added seawater lagoons is not nearly as significant as the current loads from the groundwater or the potential loads from any additional groundwater intercepted by the new marina.

- *There is a greater degree of vertical mixing with the addition of the more saline (dense) ocean water, making the nutrients more available for the benthic communities, which can lead to irreversible impacts on reef communities such as the invasive algae growth plaguing Maui County.*

  Response: The primary driver for containing the nutrients in the surface layer is the quantity of brackish groundwater intercepted by the new Marina. This is discussed at length in Chapter 6 of Appendix U. While the addition of saline water does impact this two layer system, if it is maintained, the nutrients are primarily contained in the surface layer.

- *There will be an additional increase in added pollutants and nutrients because the lagoons will act as a drainage receptacle for polluted stormwater runoff from road ways, landscaping, etc.*

  Response: In addition to mitigating impacts from runoff through the onsite drainage system, the project will employ Best Management Practices to further mitigate impacts. The following text has been added to the EIS in Section 3.9.2.2:

  <u>As a mitigation measure, bioretention, which is a Best Management Practice (BMP) is a feasible application for the proposed development. There is a probability that nutrients and other potential pollutants will runoff landscaping and impermeable surfaces such as roadways</u>

and parking lots during medium or high rainfall events. Some of these pollutants could enter the groundwater table and into anchialine pools and ultimately the ocean. As an alternative to directing runoff into the ground through drywells, storm water should be directed into bioretention areas such as constructed surface or subsurface wetlands, vegetated filter strips, grass swales, and planted buffer areas. Storm water held and moved through these living filter systems are essentially stripped of most potential pollutants, and allowed to slowly infiltrate back to the groundwater table.

- *There will be additional nutrient loading in the lagoons due to biological activity of captive animals.*

  Response: This loading was determined to be significantly less than is introduced through the groundwater. While this is not insignificant, it is not as extensive as suggested. Alternative 1 provides the opportunity to further lessen impacts due to a 74 percent reduction of the size of the seawater lagoons, from 19 to 5 acres.

Mitigation
Mitigation throughout the DEIS is "recommended" and not required. However, the analysis is based on the impact reducing effects of mitigations integrated into the proposed action. Thus, the public has no guarantee that the mitigations will be implemented, or where appropriate, enforced. Nor is the impact analysis straightforward with the level of impact unless the mitigations are required. There is no commitment from the project proponents to implement the mitigations proposed, an identification of the responsible party, a timetable for implementation, and a monitoring and reporting requirement.

Response: Hawaii Administrative Rules, Title 11, Chapter 200, do not require the DEIS to "guarantee that the mitigations will be implemented," as you assert. Rather, Section 200-17 (m) states that "The draft EIS shall consider mitigation measures *proposed* [emphasis added] to avoid, minimize, rectify, or reduce impact, including provision for compensation for losses of cultural, community, historical, archaeological, fish and wildlife resources, including the acquisition of land, waters, and interests therein." In the Kona Kai Ola EIS, the term "recommended" is used interchangeably with "proposed." The EIS will be revised to replace all "recommended" with "proposed."

Endangered Species Consultation
The DEIS does not identify consultation with the U.S. Fish and Wildlife Service and NOAA Fisheries in relation to impacts to endangered species. Because of the potential impacts to the several protected species, it appears that consultation under Section 10 of the Endangered Species Act is required. The DEIS should state "Endangered Species Act" under Federal Permits and Approvals.

Response: Kona Kai Ola will meet requirements regarding impacts to endangered species under Section 7 of the Endangered Species Act, and the EIS has been revised to add this information in Section 5.3, Permits Required for Project, Table 3, as follows:

Agency	Permit or Approval	Requirement	Time Frame
U.S. Army Corps of Engineers	Department of the Army (DOA) Individual Permit	Work in navigable waters; placing fill in waters of the U.S., placing navigation aids Will incorporate: Rivers and Harbors Act Section 10 Clean Water Act Sections 401 and 404 Coastal Zone Management Act Section 307 Endangered Species Act Section 7 National Historic Preservation Act Section 106	Prior to any in-water work or fill or placement of navigation aids or modification of terrestrial habitat that may impact species listed under Endangered Species Act
U.S. Coast Guard	Private Aids to Navigation approval	For approval for marking aids to navigation	Prior to placement. Note: placement requires DOA Permit.
State Board of Land and Natural Resources	Easement over Submerged Lands / Shared Harbor Channel Entrance	HRS Section 171-53 (6)	Prior to commencement of operations of new marina
State Department of Business, Economic Development & Tourism	Determination of Hotel Development	HRS Section 171-42	Prior to approval of Master Development Plan
State Department of Land and Natural Resources (DLNR) Office of Conservation and Coastal Lands (OCCL)	Conservation District Use Permit (CDUP)	For any work in the conservation district Kuakini Highway extension and SWAC pipe; Shoreline Park Hawaiian Cultural Park, Ocean Front Trail	Prior to any work in the conservation district
DLNR Commission on Water Resource Management	Well Construction Permit, Pump Installation Permit	For well construction or ground water source development	Prior to construction or development
State Department of Health (DOH) Clean Water Branch	401 Water Quality Certification	Triggered by DOA permit	Start simultaneously with DOA permit
	NPDES		
	- Individual Permit	Discharge into state waters	Prior to construction
	- NOI Appendix C	Construction activities on one or more acres	Prior to construction
	- NOI Appendix G	Construction dewatering	Prior to construction
	- NOI Appendix L	Discharge of circulation water from decorative ponds	Prior to construction

Agency	Permit or Approval	Requirement	Time Frame
	All NPDES applications	Copy to DLNR/State Historic Preservation Division	Simultaneously with DOH NPDES submittals
	Zone of Mixing	Include with NPDES for discharge into state waters	Concurrent with NPDES application
DOH Safe Drinking Water Branch	Water Source Approval and capacity demonstration	For new drinking water sources	After source is identified
	Operator Certification	For operators of water systems	Before system use
	Construction Plan Review	For water system improvements and connections	Before construction
	Underground Injection Control (UIC) Permit	For injection well operations	Before operations
DOH Clean Air Branch	Dust control management plan	Recommended only, not required	During construction planning
DOH Noise, Radiation, & Indoor Air Quality Branch	No permit	Comply with Administrative Rules Chapter 11-46, Community Noise Control	During construction
County of Hawai‘i	Special Management Area (SMA) Major Permit	Work in the SMA	Prior to any construction or other work in the SMA (does not include DHHL land)
	Zoning	Must be consistent with the General Plan	After acceptance of EIS
	Building Permit	To erect a new structure including fences, swimming pools and retaining walls more than 3'-0" in height, and water catchments regardless of depth or capacity	Prior to construction
	Grading, Grubbing, and Stockpiling Permits	For volumes as specified by county	Prior to activity
	Development, subdivision, drainage and flood zone reviews	For development	Prior to construction

Marine Mammals and Sea Turtles
The DEIS is completely inadequate in its assessment and discussion of the current biological conditions of these protected marine species in the proposed project area, and in the discussion of potential impacts and mitigation. The supporting studies are grossly

insufficient. Impacts to these species, particularly marine turtles and spinner dolphins will be long-term adverse significant impacts. No reasonable mitigation measures are proposed.

Response: In response to DEIS comments, Marine Acoustics, Inc., (MAI) was retained to conduct three studies, as follows:

- Description of Marine Mammal and Sea Turtles (Appendix S)
- Ambient Noise Measurements and Estimation Study (Appendix T-2)
- Acoustic Analysis of Potential Impacts (Appendix T-3)

These studies have been presented by MAI to the officials from Kaloko-Honokōhau National Historical Park and the U.S. National Marine Fisheries Service. Preliminary mitigation measures have been proposed and further refinement is being developed through consultation with both agencies. Further information on these studies will be provided in response to specific questions.

Cultural Resources
The DEIS does not identify the Ala Kahakai National Historic Trail nor the Honokōhau Settlement National Historic Landmark (which is an environmental review trigger not mentioned in Section 1.7). At the point at which the U.S. Army Corps of Engineers would consider permitting the proposed project, the USACE will be required to evaluate the project effects under both the National Environmental Policy Act and the National Historic Preservation Act, including effects on historic properties and consultation with the Advisory Council on Historic Preservation.

It appears the project will permanently destroy 101 (page 69) to 154 (page 67) known archeological sites (the DEIS is unclear about these numbers) and the mitigation that is proposed is data collection. Greater mitigation is required to reduce this impact and the permanent loss of these features. Trail 21588 and trail 7704 must be preserved.

All anchialine pools will be destroyed as a result of the proposed project. This destruction is unacceptable. These pools are both cultural and natural resources that are an important component of the cultural landscape, as well as habitat for two endemic, candidate endangered species. The suggestion that "these ponds are already degraded" (page iv), is not supported by a 2002 USGS survey of the pools and their fauna. This statement and others like it are deliberately misleading to the readers unfamiliar with the site and pools in its portrayal of the condition of the pools.

Response: While the DEIS did not specifically mention the Ala Kahakai National Historic Trail (NHT), the project developer fully intends that Kona Kai Ola support the development of the Ala Kahakai NHT as it relates to the proposed onsite trail system. To support the Ala Kahakai NHT system that is currently being developed, the project will connect pedestrian trails that connect to the project site from neighboring lands as a way to help create a trail system that could be part of the system, as well as to implement a bike path, trail system and sidewalk system to encourage these activities.

The EIS has been revised to acknowledge and support the Ala Kahakai NHT in Sections 4.1.2.1, as follows:

> "The need to revive mauka – makai trails was expressed, as well as the need to protect cultural and archaeological sites. The Ala Kahakai National Historic Trail is a system that is currently being developed to include any historic coastal trail, or connecting mauka and makai trails, along with the addition of new trails to connect these historic trails. The

mission of the National Historic Trail is to preserve in place ancient and historic trails and routes. While most of the remnant trails are partial segments of a possible historic network, there are no intact substantial segments. The project seeks to add new trails to connect any remnants from historic trails to provide a coastal trail system along the shoreline park and around the marina basins. This trail system is consistent with the goals and objectives of the Ala Kahakai National Historic Trail, and would be appropriate to be included in that system. The project will seek to improve public access, preserve and where appropriate, enhance cultural and historical features in the area."

Regarding archaeological sites, we note that the project will not "permanently destroy" known archaeological sites. Rather, the archaeological consultant states that, for some sites, "mapping, written descriptions, photography and test excavations . . . adequately documents them and no further work or preservation is recommended." The basis for determining which sites would be further studied and preserved is based on criteria outlined in the Rules Governing Procedures for Historic Preservation Review, as set forth by DLNR.

We note the discrepancy in numbers of sites stated in the EIS, the following corrections are being made to reflect accuracy:

- Section 4.2.1.1, the first sentence will be revised to read, "This inventory survey identified 58~~56~~ sites with 123~~1~~ features."

- Section 4.2.1.2, the first sentence will be revised to read, "A total of 127~~6~~ sites with 432 features have been documented within the project area."

- Section 4.2.2.2, the first bullet will be revised to read, "The mapping, written descriptions, photography, and test excavations at ~~fifty-four~~ 108 sites adequately documents them and no further work or preservation is recommended."

You state that "Trail 21588 and trail 7704 must be preserved." The reasons for not recommending preservation of these trails are as follows:

- Regarding Trail 21588, the area was surveyed three times during the fieldwork with archaeological surveyors walking at 3-5 m intervals with negative results. The same area was surveyed during preliminary studies for the project in 2004 also with negative results. Surveyors, including consultant Alan Haun, were specifically looking for worn surfaces, petroglyphs, and cairns. At the time the vegetation was not that thick. Areas of bare pāhoehoe lava were clearly visible and all were checked.

- The Archaeology Impact Study does not recommend preservation of 7704 trail because, as stated on page 227 of Appendix M-1, "The Site 7704 is an historic 19th Century trail. The absence of abrasions on the lava associated with this very straight trail led Soehren to conclude that it represented a 'preliminary route selection' for a nineteenth century horse trail that was subsequently abandoned, perhaps in favor of the 'Old Mamalahoa Trail, farther inland (Sorhren 1980:2)." In other words, the 7704 "trail' is comparable to a series of lathe stakes marking one or more alternate routes for a proposed road. One could also argue that the site's integrity was been significantly diminished by its truncation by the massive spoils pile from harbor construction.

Regarding anchialine pools, your statement that "all anchialine pools will be destroyed" is inaccurate. The DEIS presented information stating that harbor construction would cause an increase in salinity in the anchialine pools makai of the proposed marina basin to become equivalent to the ocean at 35 parts per thousand (ppt) and that the anchialine biology would then perish.

Additional studies conducted in response to DEIS comments found that there are 19 anchialine pools that would be affected. This is an adjustment based on further study that determined that three of the originally identified 22 pools are actually part of an estuary complex with direct connection to the ocean. Of the 19 anchialine pools, three pools with a combined surface area of 20m^2 would be eliminated due to the harbor construction.

The additional studies also found that changes in groundwater quality may or may not impact biological communities in the anchialine and estuarine environment. In either case, the developer is committed to practicing good stewardship over the pools to be preserved and eliminating or reducing alien species to the extent practicable. The developer recognizes it is important to understand these relationships to effectively manage the resource. If there is significant deviation from the baseline especially in regard to nutrients, pathogens, and toxins, a mitigation plan to determine the cause and take decisive appropriate action will be implemented.

Mitigation measures to facilitate the long term health of the remaining anchialine pools will be based on environmental monitoring, which is vital as an early warning system to detect potential environmental degradation. The framework for the mitigation plan will include three measures including bioretention, salinity adjustment and possible new pools. Further information on anchialine ponds is contained in subsequent responses.

Recreation

The DEIS does not include an analysis of recreational impacts. It would appear that a study of the current uses of this shoreline and the impacts of the project should have been in the DEIS, including:

- *Identifying the types of public amenities that will be provided in the parklands.*
- *Identifying the process for access including potential parking and requirements, fees, or permits for coastal access.*
- *Identifying impacts, e.g., no discussion of the potential impact of a 300% increase in boat traffic to the safety of the important free diving and spear fishing communities in Kona.*
- *Identifying the improvements to the open space and parks in the four phases of development. (Figure F does not or identify when improvements to recreation will be implemented.)*

<u>Response:</u> The DEIS covers analysis of recreation impacts in two studies. First, the Social Impact Study, which is summarized in Section 4.5, included community interviews with marine and shoreline users in particular. Findings related to these interviews are contained in Section 4.5.4.1, Issues Related to Marine and Shoreline Environment.

Second, the Marina Traffic Study includes an extensive evaluation of impacts related to adding up to 800 boat slips on navigation of recreational boat traffic within Honokōhau Harbor and the entrance channel. This study also included interviews, and harbor administrators and long time users provided information on the workings of the harbor, as well as insight on planning for future marina expansion.

Responses to bulleted comments are as follows:

- *Identifying the types of public amenities that will be provided in the parklands.*

  <u>Response:</u> Public amenities of recreational value will be provided throughout the project. The proposed 800-slip marina that will expand the region's boating opportunities and support facilities, and a 400-foot shoreline setback will provide full public access along the coast. Throughout the project site, public access trails for walking and cycling will be designed to encourage public access throughout Kona Kai Ola to utilize the public parks, canoe launching areas, cultural areas, and community facilities that are proposed as part of this project.

Specific community-oriented features include various water features such as seawater lagoons with a marine wildlife park and a marine science center, a yacht club, fishing club, a canoe park, and a cultural park with a focus on Hawaiian maritime cultural heritage of the voyaging canoe. The coastal area would be protected with a shoreline park with trails and public access parking for walking and shoreline fishing, and a cultural park surrounding the heiau, the cultural sites and ʻAlula for community use. Additional project community areas would include facilities and space for community use, including programs of the Kona Kai Ola Community Foundation that supports community programs in health care, culture, education, and employment training for the local community, especially to native Hawaiians.

- *Identifying the process for access including potential parking and requirements, fees, or permits for coastal access.*

  Response: These details will be developed as the project progresses, and through various permit applications.

- *Identifying impacts, e.g., no discussion of the potential impact of a 300% increase in boat traffic to the safety of the important free diving and spear fishing communities in Kona.*

  Response: The DEIS statement that the “new marina will result in an approximately three-fold increase in boat traffic” is inaccurate and the phrase was deleted from the EIS text. The new harbor facility will include boater safety education programs to reduce potential conflicts of use between boaters and marine wildlife, as well as boaters and other ocean users.

- *Identifying the improvements to the open space and parks in the four phases of development. (Figure F does not or identify when improvements to recreation will be implemented.)*

  Response: Figure E, Green / Open Space Plan, identifies locations of parks and community areas. Timing of the development of these facilities is based on the phasing plan, which is illustrated in Figure F, Phasing Map. The entry park, for example, would be developed in Phase 1.

Noise

There is no discussion of noise impacts to visitors to Kaloko-Honokōhau National Historical Park. Adjacent to the park boundary, seven acres are proposed as “Marina Industrial (page 12)” and will likely contain the most audible sources of noise in the entire proposed development after construction ceases. No information in the DEIS exists concerning noise impacts from construction activities such as pile driving and stationary sources such as deep water pumping equipment on park visitors, cultural activities in the park, and sensitive resources such as nesting birds.

Response: The EIS is revised to include the following discussion in Section 4.4, Noise:

> Noise impacts on the Kaloko-Honokōhau National Historical Park may result from construction activities over the duration of the 15-year construction period. However, only a small portion of the construction activities will occur in proximity to the park’s

property line. Additionally, construction activities must comply with requirements set forth in the State Department of Health noise permit.

On a long term basis, noise impacts on the Kaloko- Honokōhau National Historical Park may result from the existing Honokōhau Boat Harbor and adjacent industrial uses. Industrial and mechanical activities must comply with the State Department of Health Maximum Permissible Noise limits at the property line. Noise from the new marina may be audible but the project will comply with noise regulations to ensure that noise will remain within permissible levels.

Visual Impacts

No visual impact analysis for the surrounding area is included in the DEIS. No grading plans or site maps are provided, only a conceptual plan and a statement that hotels will be "coconut tree height" on 20-50' graded land. It is unacceptable to provide only a conceptual plan for review. Potential impacts to visual resources (makai-mauka views, views from the National Park), the terrestrial environment, water resources, cultural and archeological resources, and drainage cannot be assessed from the conceptual site plan because no elevation view is provided. Additionally, no discussion is made of night-sky pollution.

Response: A visual impact study was conducted to illustrate various views of the Kona Kai Ola development has been incorporated in Section 4.3. Attachment 3 contains the added text and related figures.

We understand that you believe it is unacceptable for "only a conceptual plan for review" and you note the absence of grading plans and site maps and that various topics cannot be reviewed "because no elevation view is provided."

We call your attention to Hawaii Administrative Rules, Title 11, Chapter 200 – 16 (e) that states "The draft EIS shall contain a project description which shall include the following information, but need not supply extensive detail beyond that needed for evaluation and review of the environmental impact:

(1) Insurance Rate Maps or Floodway Boundary Maps as applicable and a related regional map;

(2) Statement of objectives;

(3) General description of the action's technical, economic, social, and environmental characteristics;

(4) Use of public funds or lands for the action;

(5) Phasing and timing of action;

(6) Summary technical data, diagrams, and other information necessary to permit an evaluation of potential environmental impact by commenting agencies and the public; and

(7) Historic perspective.

Site plans, grading and elevation views are not required, and the information provided in the EIS is sufficient to evaluate and review environmental impact.

Regarding "night sky pollution," the project will mitigate project-related impacts related to exterior lighting as it relates to Hawaiian Petrels and Newell's Shearwaters.

Sustainability
It appears contradictory for the DEIS to state that the "vision for Kona Kai Ola is an environmentally sustainable marina focused development" while proposing such a large and consuming development. A hard look at the impacts of the project does not bear out the stated vision, including:

Response: JDI is committed to develop a project that has minimal impact on the environment by striving to significantly reduce water consumption, waste disposal, energy use and carbon dioxide emissions. The following responds to each of your points:

- *LEED Rating- The document commits that the project will go through the certification process but does not identify a goal for LEED rating. The DEIS did not commit the project to achieving a gold or platinum rating in order to meet the stated goals in the DEIS (page ii, 1st paragraph).*

  Response: The EIS has been revised to indicate the level of LEED rating with the following text: "JDI has experience with the LEED certification process from its other projects both for individual buildings, and for large campus infrastructure as well. JDI intends to pursue, at a minimum, Silver LEED certification for its development of the Kona Kai Ola project."

- *Water- Is 2.6 million gallons a day (page vii) really sustainable, especially without an identified water supply and without full knowledge of the hydrologic implications of removing that amount of water?*

  Response: As stated in the DEIS, DWS sources are inadequate to support the project. Initial coordination with DLNR has identified two possible sources that may possibly be used for the project. DLNR anticipates a sustainable yield of each well to be approximately 1.5 million gallons per day.

  - Keōpū Well #2 (State Well No. 3957-02)
  - Keōpū Well #4 (State Well No. 3857-02)

  The proposed water system will also include transmission and storage facilities. Initial communications with Queen Liliʻuokalani Trust indicates an interest in partnering with Kona Kai Ola and allowing the needed transmission main corridor/easement through their property. However, the Queen Liliʻuokalani Trust has not yet identified a development proposal on their property to the south. Water transmission corridors may alternately be coordinated with the State Department of Transportation as part of their highway improvements. While discussions continue with the Queen Liliʻuokalani Trust, the storage tank that will serve the project will be located either on TMK 7-4-08:56 or 7-4-20:22. The proposed water system improvements and proposed operation criteria are based on Chapter 5, Hawaiʻi County Department of Water Supply Potable Water System Design Standards.

  Environmental impacts resulting from the development of new water sources will be addressed in applications for a Well Construction Permit and Pump Installation Permit submitted to the State Commission on Water Resource Management. The development of new water sources will benefit the existing community by providing additional sources to meet existing and non-project future needs.

- *Energy- The DEIS discusses the environmental design and sustainable features but provides no hard commitments to meet those stated goals. For example, solar (page 124) is noted as a component of the project but there is no commitment to the* *percentage of solar that would be achieved. The DEIS did not provide the commitment the developer will make toward using a percentage of energy demand from renewable sources and include monitoring and reporting requirements to assure the public that those targets will be met. The DEIS does not quantify the amount of energy that would be required to pump the millions of gallons of water from the ocean for the proposed cooling system and the water aquarium feature.*

Response: Section 1.5.4 has been added to summarize Kona Kai Ola's energy-related goals, as follows:

Energy Related Goals

- The project will reduce building energy use by 50 percent, as compared to a building that does not incorporate energy efficient strategies (the comparison building is defined by using ASHRAE/IESNA Standard 90.1-2004). The project team has already begun analyzing the energy use in a typical timeshare. Strategies to help reduce energy use include: incorporating significant wall and ceiling insulation, utilizing windows that allow daylight without allowing heat penetration, purchasing energy efficient lighting and appliances, designing the buildings to maximize natural ventilation, and using cold ocean water for air conditioning and cooling.

- The project will use renewable energy technologies on-site to provide the remaining 50 percent of overall building energy use: On Hawai'i Island, one of the most abundant resources is solar insolation. Given the year-round abundance of solar insolation, the use of solar thermal and photovoltaic technologies is feasible for the project. The development intends to integrate these technologies into each building's architectural features. Initial calculations show that the timeshare segment can integrate enough solar technologies on each building's roof to completely offset timeshare electricity demand.

- These measures will help to reduce the site's peak energy demand by 50 percent. By reducing the development's demand during the range of hours that most of the Hawai'i Island's citizens are using electricity, Kona Kai Ola can help HELCO reduce the probability of brownouts and blackouts. The reduction in peak energy demand can be achieved by using smart technologies that control energy use.

Regarding the "amount of energy that would be required to pump the millions of gallons of water from the ocean for the proposed cooling system and the water aquarium feature," the proposed seawater air conditioning system is designed as an alternative energy option to reduce energy consumption. The specific energy requirements will be determined as the system design progresses.

- *Air Quality- The air quality section identifies the Keahole Power Plant as a "major industrial source of air pollution" (page 26). However, the DEIS does not quantify the amount of energy that will be used daily, monthly, and yearly at the development and the impacts of that energy use on air quality.*

Response: In response to your comments, the following text has been added to Section 3.5:

Based on standard planning estimates, the peak electrical demand of the project when fully developed is expected to reach about 70 MW. Assuming the average demand is approximately one-half the peak demand, the annual electrical demand of the project will reach approximately 300 million kilowatt-hours.

Electrical power for the project will most probably be provided mainly by oil-fired generating facilities, but some of the project power may also be derived from geothermal energy, wind power or other sources. To meet the electrical power needs of the proposed project, power generating facilities will likely be required to burn more fuel and hence more air pollution will be emitted at these facilities. The following table provides estimates of indirect air pollution emissions that would result from the project electrical demand assuming all power is provided by burning more fuel oil at local power plants.

Estimated Indirect Air Pollution Emissions From Kona Kai Ola Project Electrical Demand

Air Pollutant	Emission Rate (tons/year)
Particulate	86
Sulfur Dioxide	780
Carbon Monoxide	70
Volatile Organics	8
Nitrogen Oxides	340

Based on U.S. EPA emission factors for utility boilers. Assumes peak electrical demand of 70 MW and that the average electrical demand is one-half the peak demand, resulting in 300 million kw-hrs per year of electrical power use. Estimated emission rates assume low-sulfur oil used to generate power.

These values can be compared to the island-wide emission estimates for 1993 (the latest estimates available) contained in the following table. The estimated indirect emissions from project electrical demand amount to about 8 percent or less of the present air pollution emissions occurring on Hawaii Island assuming all project power is derived from oil.

Air Pollution Emissions Inventory For Island Of Hawaii, 1993

Air Pollutant	Point Sources (tons/year)	Area Sources (tons/year)	Total (tons/year)
Particulate	30,311	9,157	39,468
Sulfur Oxides	9,345	nil	9,345
Nitrogen Oxides	4,054	8,858	12,912
Carbon Monoxide	3,357	23,934	27,291
Hydrocarbons	1,477	203	1,680

Source: Final Report, "Review, Revise and Update of the Hawaii Emissions Inventory Systems for the State of Hawaii", prepared for Hawaii Department of Health by J.L. Shoemaker & Associates, Inc., 1996

- *Wastewater- the DEIS identifies needed improvements at the wastewater treatment plant (page 122). However, the DEIS fails to identify who will be required to make the improvements to the plant, when they will be accomplished, and how that fits into the proposed development's schedule.*

  Response: The developer will be responsible for contributing the project's pro rata share in the required improvements to the plant. The timing of these improvements is dependent on implementation of County plans to upgrade the Kealakehe WWTP. Hawaii County is currently preparing these plans.

- *Solid Waste- the assertion in the DEIS that "an extensive recycling program that will reduce waste generated on site by 90 percent" (page 103) is a good intention but has not* *been proven realistic. A waste reduction rate of 50% is considered standard. The goal appears equally ambitious because the DEIS provides no exact plans on the development of recycling and composting and how it will be achieved.*

Response: The EIS has been revised to expand the discussion on sustainability waste-related goals:

Waste Related Goals

- The project will divert over 50 percent of the waste generated during construction. The preparation of a site and the eventual construction of buildings and site infrastructure generate significant amounts of waste. By identifying construction and site materials that can be reused or recycled on or off-site, the Kona Kai Ola project will reduce construction waste by at least 50 percent. Prior to the beginning of construction activities, a construction waste management plan will be developed that will lead to a 50 percent reduction in construction waste. Polluted runoff will be treated using structural and non structural Best Management Practices before the water is released to the marina.

- To further prevent polluted runoff, bioretention, which is a Best Management Practice (BMP), is a highly appropriate application for the proposed development. Storm water should be directed into bioretention areas such as constructed surface or subsurface wetlands, vegetated filter strips, grass swales, and planted buffer areas. Storm water held and moved through these living filter systems are essentially stripped of most potential pollutants, and allowed to slowly infiltrate back to the groundwater table.

- The development will include the creation and maintenance of an extensive recycling program that will reduce waste generated on site by 90 percent.

- Project components will produce compost for use on and off site. The restaurant operations and timeshare buildings will generate large amounts of compostable material from food preparation and consumption. Rather than dispose of this material, it can be composted and used as a natural fertilizer.

- *Drainage- although JDI claims to be a sustainable developer, no discussion of innovative sustainable stormwater best management practices to protect receiving water bodies from nonpoint source pollution were offered in the DEIS. The majority of the proposed project site would be converted to impermeable surface. Surface water runoff during even low rainfall as described in the DEIS will carry pollutants and nutrients to the groundwater, and the harbor basin, via the standard county drywell system, which is a hole in the ground that does not filter pollutants. The constructed lagoon and water features would also be a drainage collection area with point source discharge to harbor waters and ultimately Class AA waters in the National Park.*

Response: The EIS has been revised to include the following text in Section 3.3.3, Subsurface Geology and Section 3.9.2, Anchialine Pools.

As a mitigation measure, bioretention, which is a Best Management Practice (BMP), is a feasible application for the proposed development. There is a probability that nutrients and other potential pollutants will runoff landscaping and impermeable surfaces such as roadways and parking lots during medium or high rainfall events. Some of these pollutants could enter the groundwater table and into anchialine pools and ultimately the ocean. As an alternative to directing runoff into the ground through drywells, storm water should be directed into bioretention areas such as constructed surface or subsurface wetlands, vegetated filter strips, grass swales, and planted buffer areas. Storm water held and moved through these living filter systems are essentially stripped of most potential pollutants, and allowed to slowly infiltrate back to the groundwater table.

In addition, the following text has been added to Section 3.4, Natural Drainage:

Specific design plans will be determined during the permitting process when final designs are developed. It is the intent of JDI to stipulate low impact development techniques as part of the general design guidelines. The Best Management Practices (BMPs) will be very site specific and must be incorporated with the building and landscape design. BMPs will be incorporated to minimize runoff volume and peak flow, minimize the quantity of pollutants in runoff or flows to groundwater, and maximize re-use of storm water for natural irrigation. Specific BMPs will be reviewed as part of the application for the National Pollutant Discharge Elimination System (NPDES) permit which will be required prior to the County's issuance of a grading permit.

***Project Compatibility with Existing and Emerging Community*.**
Urban development is rapidly expanding along the Kailua-Kona, Queen Ka'ahumanu Highway corridor. However, within this corridor, Kaloko-Honokōhau National Historical Park is a significant parcel and is a natural and cultural resource of the utmost value both to the State of Hawaii and the nation as a whole. The National Park represents some of the State's most important natural systems, habitats, and valued cultural, historical, and natural resources. These nationally significant resources are to be perpetuated and protected forever. The National Park also has significant economic value for the central Kona coast. Degradation of Park resources would mean a negative economic impact for the region. Therefore, the new urban community must coexist with the National Park and to do so, must take significant measures to protect it.

Response: Kona Kai Ola is being designed to be a mixed urban land use with features and components that enhance the project's compatibility with the Kaloko-Honokōhau National Historical Park, and that are also consistent with the land's State Land Use designation of "Urban", and its Hawai'i County Land Use designation of "Urban Expansion Area."

There are two locations where the project site is adjacent to the lands designated as part of the Kaloko-Honokōhau National Historical Park. One location is between the DLNR property and the park property at Queen Ka'ahumanu Highway and extending west for 1000'. The other area is on the western boundary of the project site, where 15 acres of the project site are within the legislative designated boundaries of the Kaloko-Honokōhau National Historical Park. This is in the area south of the harbor entrance channel, and includes areas of heiau, anchialine pools, Alula beach, and other significant cultural and natural resources.

The boundary shared by the northern boundary of the DLNR parcel and the southern boundary of Kaloko-Honokōhau National Historical Park is the closest the project gets to the National Park owned land. The rest of the southern boundary of the Kaloko-Honokōhau National Historical Park is shared with DLNR DOBOR land of the Honokōhau Small Boat Harbor. The property line between the National Park and Kona Kai Ola runs perpendicular to Queen Ka'ahumanu Highway extending 1000' in from the highway right of way.

Plans for this area in the initial proposed development plan were for "Community Use." JDI received direction from DLNR, the land owner, on their preference for having different land uses in this area. JDI also received input from the community on their preference of a different location for the community area.

Consequently, the proposed use in this area was changed in Alternative 1 to commercial, and marina industrial. A buffer of some distance from the property boundary would be beneficial to both property owners. The planting of screening along the boundary could be considered, especially if it is done with either native plants or Polynesian introductions.

Since the proposed frontage road is included in the Kona Community Development Plan as part of the regional Transit Oriented Development Plan, Kona Kai Ola is seeking to be consistent with this County-initiated plan. Hence, Alternative 1 includes a transit stop at Kona Kai Ola, and a road that could be extended in the future to be the proposed frontage road. Since the Kaloko-Honokōohau National Historical Park has not approved this frontage road, the plan does not show the road entering park property, but rather terminating in a cul-de-sac on the DLNR property.

Protection of these cultural and natural resources is a high priority for Kona Kai Ola. Initial steps taken by Jacoby Development, Inc. (JDI) was to modify the initial conceptual master development plan which had a 40' setback from the shoreline, and move the developed area back over 400' from the shoreline to protect the 15 acres of National Park designated lands. The additional studies done in direct response to your comments on the anchialine pools has provided us with the information on how we will be able to restore these anchialine pools, monitor and manage the pools, and ensure that a brackishwater anchialine ecosystem thrives that is healthy to the opae ula and other flora.

This includes mitigation measures to adjust salinity of the pools if they experience salinity levels unhealthy to opae ula and other fauna. JDI also intends to encourage the cultural practice in the community of cultivating opae ula, gathering it, and feeding the fishing ko`a located in the nearshore waters. In addition, JDI has also included mitigation plans to expand opae ula habitat through the creation of new anchialine pools on the project site.

Any work that would be done in the area within your legislative boundaries would be done in close consultation with all the necessary regulatory bodies, and include the Kaloko-Honokōhau National Historical Park and the Advisory Council on Historic Preservation.

Protection of the important cultural features extends beyond the boundaries of the legislatively designated lands of the Kaloko-Honokōhau National Historical Park. The specific sites to be preserved are identified in the EIS as well as the plans to create a coastal trail to be linked to the Ala Kahakai National Historic Trail system. These proposed coastal trails would be built in a style that is compatible with the natural lavascape along the shoreline, and would require permission from all necessary regulatory authorities.

Adjacent to the Kona Kai Ola coastal Cultural Park, the project plan includes the establishment of a cultural center focusing on the cultural history of this ahupua`a, its maritime heritage, and connection to the sea. The cultural center would also focus on the Hawaiian voyaging canoe, and all the mele, hula, food, tradition, and cultural practices associated with the canoe. Kona Kai Ola hopes to be a homeport of a voyaging canoe, and location for canoe builders to share their craft.

As was discussed at the April 28, 2006 meeting of Na Hoapili o Kaloko Honokōhau Advisory Commission, there is an opportunity at Kona Kai Ola to fulfill one of the objectives of the Kaloko-Honokōhau National Historical Park, which is to establish off-site orientation programs for visitors to the Kaloko-Honokōhau National Historical Park. JDI is interested in offering these visitor orientation programs at the cultural center, or community center, or other location on the Kona Kai Ola project site. This visitor orientation center could be a productive collaboration between Kona Kai Ola and Kaloko-Honokōhau National Historical Park. This proposed partnership with the Kaloko-Honokōhau National Historical Park for cultural programs is consistent with the focus of the Kona Kai Ola project on the ocean, the Hawaiian voyaging tradition, and telling the stories of the land. The partnership also increases the compatibility between the Kona Kai Ola project and the Kaloko-Honokōhau National Historical Park.

Protection of water quality, groundwater, anchialine pools, protected marine species and underwater noise were among the many top priority concerns of the Kaloko-Honokōhau National Historical Park. In direct response to these comments and concerns, JDI has had substantial additional scientific work done for the EIS on groundwater, water quality circulation modeling, the anchialine pools, and protected marine species and underwater sound.

Specific changes in the project's design were made after considering the results of the additional water quality circulation modeling. The 45-acre harbor was downsized to 25 acres in Alternative 1 to make sure the water circulated well enough to ensure maintaining required water quality standards. Reducing the size of the new harbor allowed JDI to reduce the number of units of hotel and timeshares, from 2,500 proposed units to 1,500 proposed units. The size of the proposed seawater lagoons was also reduced by 74% to address the National Park's concerns about potential impacts of the volume of seawater discharging from these lagoons. This overall reduction in number of hotel and timeshare units for the Kona Kai Ola project has the result of reducing overall traffic and other impacts of the original proposed project.

JDI is committed to protecting groundwater quality through best management practices on site using innovative mechanisms for nonpoint source pollution control that would be very site specific and incorporated into the building and landscape design. The best management practices will be incorporated to minimize runoff volume and peak flow, minimize the quantity of pollutants in runoff or flows to groundwater, and maximize re-use of storm-water for natural irrigation.

Project Compatibility with Existing and Emerging Community (continuation).
Regional plans and urban development plans must take into consideration the presence of these resources, their physical and biological requirements for continued existence, and the necessity of protecting them for the benefit of the community and the nation. Environmental review for developments adjacent to a National Park must, therefore, be quite rigorous, more rigorous than what may be expected for properties not adjacent to a National Park. A landmark Findings of Fact, Conclusions of Law, and Decision and Order by the State of Hawaii Land Use Commission in 2002 stated, in considering development neighboring the National Park, "...for all proposed development adjacent to or near a National Park that raises threats of harm to the environment, cultural resources, or human health, precautionary measures should be taken to protect the National Park's cultural and natural resources, even if some cause and effect relationships are not fully established scientifically" (LUC 2002, Finding of Fact #165). For developments farther from Park boundary than the proposed Kona Kai Ola project, the LUC found that additional stringent measures of protection against nonpoint source pollution of groundwater must be taken for development adjacent to the National Park (LUC 2002, FF #307, #321; Decision and Order). Review of the DEIS shows that the proposed development is wholly incompatible with the National Park, and will have major, adverse long-term irreversible impacts to the Park and its cultural and natural resources. The scientific studies are inadequate to demonstrate "no impact" to the Park and therefore precautionary measures must be taken. No reasonable or effective mitigation are proposed to protect the National Park.

Response: We acknowledge your comments concerning the Decision and Order of the State of Hawaii Land Use Commission in 2002. We understand that in 2002 the Land Use Commission approved the reclassification of approximately 102 acres of land in the State Conservation District to the Urban District to allow the completion of the development of the Kaloko Industrial Park for light industrial and industrial-commercial uses. In 2003, the Land Use Commission also approved the reclassification of approximately 337 acres from the Conservation District to the Urban District to allow the development of the West Hawaii

Business Park, which also features light and heavy industrial uses (including an existing quarry) and commercial uses. These industrial and commercial developments are located on land directly upslope from the Kaloko-Honokōhau National Park, separated only by the Queen Kaahumanu Highway.

We concur with the Land Use Commission's determination that for all proposed development adjacent to or near the Kaloko-Honokōhau National Historical Park that raises threats of harm to the environment, cultural resources, or human health, precautionary measures should be taken to protect Kaloko-Honokōhau National Historical Park's cultural and natural resources, even if some cause and effect relationships are not fully established scientifically. As with the industrial and commercial uses approved by the Land Use Commission in the referenced dockets, we also concur that for the marina support and commercial uses within the Kona Kai Ola project, adequate measures to mitigate potential nonpoint source pollution should be implemented in consultation with the National Park Service. We welcome the opportunity to work with the National Park Service to develop appropriate mitigation measures.

NATIONAL PARK SERVICE SPECIFIC COMMENTS ON KONA KAI OLA DEIS

Section 1.4 Purpose and Need for the Project

The purpose and need statement does not adequately describe the need for the proposed project at the full-scale preferred alternative. Nor does it provide adequate information required for public review. The lease agreement with the Department of Hawaiian Home Lands (DHHL), and the development agreement with the Board of Land and Natural Resources requiring the 45-acre basin and 800 slips along with the rational that this requirement was based upon, should be disclosed to the public for review and comment as an appendix in the draft environmental impact statement (DEIS). No information is provided to the public on how the DLNR-required build out density was determined. An environmental review is required for establishing these specific marina criteria. No explanation of the ratio of costs per acre of marina basin or per slip that requires the proposed density of the development is provided. Are the facilities for the lagoon system factored into this ratio of costs? The applicant, Jacoby Development Inc (JDI), states (Section 2, page 19) that "the density proposed for the income generating features of the development must be sufficient to provide an acceptable level of economic return for JDI." However, no information is provided to the public on what constitutes an acceptable level of return for JDI that justifies the need for this scale of the development, or the inclusion of the water features (not required by the lease agreement).

The market analysis (Appendix B, page 12) points to the need for 200-300 slips, not 800, and the DEIS (page 13 Section 1.6) states that "Installation of the boat slips would be constructed as the market warrants over the 15-year build out of the project." In phase 2 of the build out, 2-5 years into project, "Approximately 100 slips will be built" (Section 1.6.2, pg 15). The remainder of the slips is projected to be built in phase 3 and 4, 9-15 years into the project (Section 1.6.2, pg 16). Justification of need is not provided for committing the community of Kailua-Kona to a development of this magnitude (three hotels and 1800+ timeshare units, 19 acres of seawater "Water Feature") and foreclosing other future options for the area.

Response: HRS Chapter 343 does not require the inclusion of lease and development agreements in the EIS. These documents are public record with the respective agencies. Please refer to our response on page 2 regarding the expanded discussion of alternatives analysis.

Regarding the market analysis, page 12 of Appendix B does not reference "200-300 slips," but rather states that there are 146 people on the waiting list for slips at Honokōhau Harbor, and a 15-20 year wait. Further, on page 13, it states "We forecast the 800 subject marina slips would require approximately 11 years to reach full absorption after completion of the basin and moorage infrastructure; or an average of 73 slips per year. However, it is anticipated about half the slips would be spoken for in the first three-plus years.

Section 1.5.2 Project Sustainable Design
There are large differences between silver, gold, and platinum LEED certification. It is not stated what degree of LEED certification JDI is proposing. A commitment in the DEIS to achieving platinum or gold rating would have to be made to meet stated goals in the DEIS (page ii).

Response: As stated on page 15 of this letter, JDI intends to pursue, at a minimum, Silver LEED certification for its development of the Kona Kai Ola project."

Section 1.6.2 Phase 2
Figure F shows a large commercial parcel immediately adjacent to the National Park boundary and a marine industrial parcel, adjacent to water, close by. Will this parcel be developed similarly to other nearby commercial parcels, i.e., as light industrial or industrial?

The property line between the National Park and Kona Kai Ola runs perpendicular to Queen Kaahumanu Highway extending 1,000' in from the highway right-of-way. Plans for this area in the initial proposed development plan were for "Community Use." JDI received direction from DLNR, the land owner, on their preference for having different land uses in this area. JDI also received input from the community on their preference of a different location for the community area. Consequently, the land use in this area was changed in Alternative 1, to be commercial, and marina industrial. A buffer of some distance from the property boundary would be beneficial to both property owners. The planting of screening along the boundary could be considered, especially if it is done with either native plants or Polynesian introductions

Section 1.6.2 Phase 2 (continuation)
A 2002 decision by the Hawaii Land Use Commission found that for developments farther from Park boundaries than Kona Kai Ola, additional measures of protection against nonpoint source pollution of groundwater must be taken when development is adjacent to a National Park (Hawaii LUC 2002). No discussion is provided in the DEIS regarding impacts from industrial development, buffers, mitigation, and safeguards to protect National Park resources from commercial industrial park- generated pollutants associated with the project. Will pollution prevention plans be required for each lot? Will Covenants, Conditions, and Restrictions be developed for stormwater runoff from industrial lots as with other industrial parks neighboring the National Park (LUC 2002)? These questions were asked by the NPS in our response letter to the EIS preparation notice (Appendix A); however the response was unsatisfactory and only mentioned the LEED certification, not nonpoint source pollution controls. If the DEIS is intended to serve as the environmental review document for all parcels, then specific consideration of impacts and mitigation must be given in detail for all land use types. This document appears to focus only on the marina and water features.

Response: Please refer to discussion on page 19 regarding our response on the 2002 Hawaii Land Use Commission decision.

JDI is committed to protecting groundwater quality through best management practices on site using innovative mechanisms for nonpoint source pollution control that would be very site specific and incorporated into the building and landscape design. The best management practices will be incorporated to minimize runoff volume and peak flow, minimize the quantity of pollutants in runoff or flows to groundwater, and maximize re-use of storm-water for natural irrigation

Section 1.6.4 Phase 4
As written, the phasing of the project appears to include the entire basin excavation in Phase 2, but with only 100 slips installed at that time. Four hundred slips will be added during Phase 3, and the remaining 300 slips added during Phase 4 (15 years later). No mention, or analysis, in the DEIS is made regarding potential environmental impacts of adding new slips after the opening of the basin. Will there be pile driving (which will include noise effects) or sedimentation issues during these later installations? What mitigation measures are proposed at those times? (See comments regarding inadequacy of proposed mitigation for noise and sediment Section 3.9.5.2 and 3.3.4).

Response: The land bridge will be in place until final stages of marina construction, which means through Phase 4. Silt curtains will be used to contain the temporary sediment plume after the land bridge is removed and prevent it from entering the nearshore waters. Section 3.9.3 has been revised to expand discussion on mitigation measures related to this matter as follows: "Marina construction will be accomplished with a berm separating the construction area from adjacent marine waters, minimizing the discharge of sediment from excavation and dredging. Excess sediment remaining in excavated marina will be removed before the land bridge is removed in order to minimize any temporary sediment plume. When the final land bridge is removed, a temporary sediment plume is anticipated. Silt curtains will be used to prevent suspended sediment entering ocean waters."

Noise impacts related to marina construction are discussed in previously and in subsequent sections of this letter.

Section 1.7 Environmental Process
The DEIS does not disclose that an environmental review is also triggered by actions that "Propose any use within any historic site as designated in the National Register or Hawaii Register, as provided for in the Historic Preservation Act of 1966. Public Law 89-665, or Chapter 6E" [HRS 343-5(a) (4)], and that a portion of the project area includes significant features of the Honokōhau Settlement National Historic Landmark (1962). All National Historic Landmarks (NHL) are on the National Register. All of the anchialine pools within the Kona Kai Ola project area are significant cultural features and are contributing elements to the NHL as described in its nomination. These features will be destroyed by the project action. The National Park Service pointed this fact out to JDI in our response to the EIS preparation notice (Appendix A). However the DEIS does not respond to these comments regarding the NHL, as required under HRS 343, except to copy a portion of our letter into Section 1.3 describing the authorization of the National Park. The Honokōhau Settlement National Historic Landmark did not cease to exist upon authorization of the National Park. No mention is made in the DEIS of any contact or consultation with the Advisory Council on Historic Preservation regarding proposed impacts to the NHL. (See additional comments in Section 5)

Response: We understand that there are 15.5 acres of State land on the south side of the existing harbor, which are within the project area, and which are part of the Kaloko-Honokōhau National Historical Park and also part of the Honokōhau Settlement National Landmark, and thus on the National Register of Historic Places. We further understand that this is a trigger for an EIS under HRS 343, and have revised Section 1.7, as follows:

> Of the nine land uses or administrative acts that trigger environmental review under HRS 343, the following are relevant to the proposed project:

- The project involves State lands;
- The project site includes lands in the -shoreline area; and
- ~~The project requires an amendment to the Hawai'i County General Plan~~
- A portion of the project site is on the National Historic Register.

As stated on page 19 of this letter, any work that would be done in the area within your legislative boundaries would be done in close consultation with all the necessary regulatory bodies, and include the Kaloko-Honokōhau National Historical Park and the Advisory Council on Historic Preservation.

Section 2 Alternatives Analysis
According to Hawai'i Administrative Rules, Chapter 200, §11-200-17 (F). Content Requirements, Draft Environmental Impact Statement [relating to Alternatives]: "The section shall include a rigorous exploration and objective evaluation of the environmental impacts of all such alternative actions. Particular attention shall be given to alternatives that might enhance environmental quality or avoid, reduce, or minimize some or all of the adverse environmental effects, cost, and risks. Examples of alternatives include:
1. The alternative of no action
2. Alternatives requiring actions of a significantly different nature which would provide similar benefits with different environmental impacts:
3. Alternatives related to different designs or details of the proposed actions which would present different environmental impacts
4. The alternative of postponing action pending further study: and,
5. Alternative locations for the proposed project."

The single alternative considered in the DEIS is "no action." Therefore the DEIS does not meet legislated requirements and cannot be accepted. Section 11-200-17 (L) of the HAR further requires "The statement shall also indicate the extent to which these stated countervailing benefits could be realized by following reasonable alternatives to the proposed action that would avoid some or all of the adverse environmental effects." Although there are many, one example is the DEIS does not explore the alternative of no lagoon and water features, which pose a significant threat to natural and cultural resources in the National Park waters. (See comments on the water feature impacts in Sections 3.9 and 4.10.10)

Response: Please see our response on page 2 of this letter regarding alternatives analysis.

Regarding alternatives related to marina development, multiple alternatives for the project were considered, and are described at length in Chapter 5 of Appendix U, which is one of the additional studies conducted in response to DEIS comments; this report is contained in Attachment 2-A. The options considered included location of the piped exhibit discharge, and decreasing the size of the proposed marina. It also includes a detailed discussion of the effects of including or not including the lagoon discharges into the system. The impacts on Harbor and surrounding waters for each of the alternatives are discusses at length. The dependency of the harbor waters on the quantity of brackish inflow is obvious from the discussion. While this value is yet unknown, a discussion of mitigation measures that could be implemented given various scenarios is also presented.

Section 3.3.4 Subsurface Geology, Anticipated Impacts and Recommended Mitigation. *The DEIS does not provide a current topographic map, descriptions of the proposed final topography, or clear estimates of ground and building elevations planned for the site. No opportunity exists for public review of how significantly the natural grade will be altered, or how the significant grading potentially impacts the following resources: visual resources (mauka to makai views, views from the National Park), terrestrial environment, water* *resources, cultural and archeological resources, and drainage. Potential impacts to these resources cannot be assessed from the conceptual site plan provided, because no proposed elevation view is given and no visual impact analysis of the proposed layout was made. Buildings up to 4-stories in height are proposed on 20-50' graded land (page 28). The DEIS states (pages 72, 113, 145) there will be a "coconut tree height" general limit on buildings. However, no actual metric is provided for this limit and it is not clear whether "coconut tree height" will be measured from the natural grade, new grade or a baseline of sea level.*

Response: A topographic map has been added to the EIS and is included as Attachment 4 to this letter. Please see page 14 regarding our response to your statements regarding more information related to ground and building elevations.

Section 3.3.4 Subsurface Geology, Anticipated Impacts and Recommended Mitigation (continued)
Silt curtains to retain sediments are proposed for use when the new marina basin is opened to the coastal waters (page 25). The effectiveness of this mitigation for this size of construction is unstated. Additionally, no mitigation measures are proposed for the subsequent slip construction phases after the basin is open, or during land-based construction and grading, which will continue for some 11-15 years (Section 1.6 Phasing).

Response: The use of land bridges and silt curtains is an accepted and proven construction technique to prevent sedimentation from entering coastal waters. Silt curtains have been used successfully to contain suspended solids in Kalaeloa Deep Draft Harbor construction where water depth is 30 feet. Section 3.9.3 has been revised to expand discussion on mitigation measures related to this matter as follows: "Marina construction will be accomplished with a berm separating the construction area from adjacent marine waters, minimizing the discharge of sediment from excavation and dredging. Excess sediment remaining in excavated marina will be removed before the land bridge is removed in order to minimize any temporary sediment plume. When the final land bridge is removed, a temporary sediment plume is anticipated. Silt curtains will be used to prevent suspended sediment entering ocean waters." Mitigation measures recommended by MAI shall be implemented to reduce potential impacts of marina construction work.

Section 3.4 Natural Drainage
The statement "Even in the event of heavy rainfall, which is more than two inches in one hour (NOAA 2006) the porous nature of the ground is such that sheet flowing to the shore does not occur" (page 26), is incorrect and unsupported by reports or data. Furthermore, "more than 2 inches in 1 hour" is not the National Weather Service (NWS) definition of "heavy rainfall." Examination of the NOAA 2006 website cited, also does not provide the definition stated in the DEIS. "Heavy Rainfall" is based on rate-of-fall and is defined by the NWS as "more than 0.3 inch per hour; more than 0.03 inch in 6 minutes. Rain seemingly falls in sheets: individual drops are not identifiable: heavy spray to height of several inches is observed over hard surfaces" (NWS 1997). Sheet-flow does occur on the project site. On July 29, 2006 the remnants of Hurricane Daniel passed the west coast of the Big Island. Between 7:00 and 8:00 pm, rainfall measuring 1.08 inches was recorded by the NPS remote automated weather station located on the northern boundary of the project site (data for this station can be accessed at the following web site http://www.wrcc.dri.edu!cgi-binlrawMAIN.pl?hiHKAL). During that hour, NPS staff observed large quantities of water flowing as sheet flow across both areas of natural, unpaved ground and man-made impervious surfaces carrying sediment into the existing harbor basin.

Response: In response to your comment, the EIS has been revised as follows:

Due to the high surface permeability and lack of a naturally developed drainage system, it appears that there is not a significant amount of storm runoff entering the ocean from the project site. Storm runoff will generally be retained in hummocky surface of the a'a and pahoehoe flows and either infiltrate into the ground or evaporate. The 2-year, 24 hour rainfall at the site is between 4.0 and 4.5 inches (NOAA-NWS Technical Paper No. 43). This intensity would produce overland flow but most of the rainfall would be stored in the irregular topography of the site.

~~Due to the low rainfall levels in the project area (15-20 inches average annual rainfall – (NOAA 2006)), and the lack of streams or other major drainage ways in the immediate area, it appears that there is not a significant amount of storm water currently flowing across the property. Further, no natural gulches, streams or defined drainage ways are located on the project site. Even in the event of heavy rainfall, which is more than two inches in one hour, (NOAA 2006), the porous nature of the ground is such that sheet flowing to the shore very rarely occurs. The naturally occurring precipitation mostly infiltrates into the ground.~~

Anticipated Impacts and Proposed Mitigation

The project site will be designed to comply with Department of Health rules on stormwater runoff. BMPs will be implemented so that the project site will retain runoff from a 2-year 24-hour storm. Low points will be created at roadway intersections to allow storm runoff to stay within the proposed roadways and not into developable parcels. Mitigation measures will include the provision of storm drains and drywells at strategic locations to intercept storm runoff from the roadways and lead it into the ground. Bioretention, a BMP which was discussed in Section 3.4, would be a feasible application for the proposed development. Specific BMPs will be reviewed as part of the application for the National Pollutant Elimination System (NPDES) permit which will be required prior to the County's issuance of a grading permit.

Compliance with public regulations will further mitigate project impacts. According to Chapter 10 of Hawai'i County Code, all grading, grubbing, and stockpiling permits and operations shall conform to the erosion and sediment control standards and guidelines established by the Department of Public Works in conformity with Chapter 180C, Hawai'i Revised Statutes.

Section 3.4 Natural Drainage (continued)

The DEIS does not describe the environmental impacts from stormwater runoff to the marina, and no measures to mitigate these impacts are provided in the proposed drainage system for the project. In fact, minimal information is given on the proposed drainage system, which is disproportionate to the large impact the fate of drainage will have. It is simply stated in the DEIS that drainage will be led "to the ground" (page 26, paragraph 2), discounting that this runoff will join the groundwater and exit into the harbor and ultimately the coastal waters. "Sheet flow" of storm runoff will occur on the proposed development. Surface water runoff during even low rainfall will carry pollutants and nutrients to groundwater and the harbor basin. The constructed lagoon and water features will also be a drainage collection area. The mitigation should take into account at least a 10-year storm event. Mitigation measures to address the quality of stormwater runoff should be presented. How fertilizers, pesticides, and volatile organic chemicals will be managed and minimized on site is not presented. The DEIS should outline the overall stormwater management plan, impacts, and mitigation measures for surface water drainage, and must not to defer this responsibility to the individual parcels or the County of Hawaii.

Response: The drainage system for Kona Kai Ola, which is summarized in Section 4.10.5, Drainage and Storm Water Facilities, will meet current County of Hawaii drainage standards and include measures to handle stormwater. Specific measures will be detailed in applications for an Underground Injection Well Permit from the Department of Health and a National Pollutant Discharge Elimination System permit.

The following text has been added Section 3.4 to expand discussion on mitigation:

> Typical Low Impact Development standards call for retention of the 1-year 24-hour storm. The State of Hawai'i Department of Health has recently discussed requiring new development designs that would retain a 2-year 24-hour storm. For the following events on the project site the precipitation amounts are as follows:
>
> - 1-year 24-hour is 2-2.5 inches
> - 2-year 24-hour is 4-4.5 inches
> - 10-year 24-hour is 4.5-6 inches
>
> *(NOAA-NWS Technical Paper No. 43)*
>
> Specific design plans will be determined during the permitting process when final designs are developed. It is the intent of JDI to stipulate low impact development techniques as part of the general design guidelines. The Best Management Practices (BMPs) will be very site specific and must be incorporated with the building and landscape design. BMPs will be incorporated to minimize runoff volume and peak flow, minimize the quantity of pollutants in runoff or flows to groundwater, and maximize re-use of storm water for natural irrigation. Specific BMPs will be reviewed as part of the application for the National Pollutant Discharge Elimination System (NPDES) permit which will be required prior to the County's issuance of a grading permit.
>
> Alternatives 1 and 2 would generate similar levels of impacts on natural drainage and thus require similar mitigation measures.

Section 3.5 Air Quality; Appendix C Air Quality Study
The project has the potential to significantly impact air quality. A quantitative analysis using updated models and local measurements for all air quality parameters was not conducted to assess the impacts from the proposed development to the region's air quality.

Response: As stated in the Air Quality Study, for a development of this nature, the primary source of air pollution will be motor vehicles coming to and from the project area. On a local scale, carbon monoxide is the most significant issue. The impact of carbon monoxide emissions from project traffic was quantitatively assessed using current models recommended by the U.S. Environmental Protection Agency. On a regional scale, the issues are more about nitrogen oxides and ozone. For a project of this size and type, it is not practical to quantitatively address these issues. The evaluation of regional air quality impacts for a single project such as Kona Kai Ola is not typically required. Such a study is typically conducted by a State or County agency and for cumulative projects and expected population growth combined. Nevertheless, even in highly urbanized Oahu, regional measures of air quality (nitrogen dioxide and ozone) consistently meet air quality standards.

Section 3.5 Air Quality; Appendix C Air Quality Study (continued)
The study in Appendix C is qualitative, which is insufficient to address the air quality issues at the site. The study relies on limited data measured far from the site, an outdated model using national average values, and incorrect assumptions regarding traffic flow in the surrounding area. Stating that carbon monoxide concentrations from vehicle emissions (as a result of the development) will remain within state and federal standards is not a measure of the impact to air quality from the proposed development. The proposed development will

produce more vehicle emissions in an increasingly congested area. As a result, carbon monoxide concentrations will increase.

Response: The air quality study quantitatively assesses the impacts of carbon monoxide emissions from roadway traffic. The assessment was done using computer models recommended by the U.S. Environmental Protection Agency. Only very limited data are available to characterize existing conditions. Traffic data for the air quality analysis was obtained from the project traffic study. The air quality study shows that carbon monoxide concentrations were predicted to increase with the project at the three locations studied, but the worst-case concentrations should remain within ambient air quality standards.

Section 3.5 Air Quality; Appendix C Air Quality Study (continued)
Currently, air quality in the proposed development area is impacted by vehicle exhaust from a busy highway, mineral particles from land clearing activities (including highway expansion), airplane exhaust, two rock quarries, an asphalt plant, a solid waste dump, vog (aerosols from Kilauea volcano), local aerosol-producing activities, and to a much lesser extent by periodic incursions of Asian dust. These air pollution sources and concerns are not adequately addressed, and a quantitative study was not performed that shows current measurements in the project area of total suspended particulates, lead, nitrogen dioxide, carbon monoxide, ozone, and sulfur dioxide.

Response: The proposed project has no control over other sources of air pollution in the area. Primarily, the only air pollution emissions from the project will occur from motor vehicle traffic. Impacts on air quality from project motor vehicle traffic were assessed to the extent feasible.

Section 3.7.1 Flora
A culturally important plant, the sedge makaloa (Cyperus laevigatus) was not included in the plant survey but exists along the edges of some anchialine pools on the site.

Response: The Flora Survey found that, in the southern anchialine pool complex, the smaller pools were either devoid of vegetation or were filled in with mats of the common native 'akulikuli (*Sesuvium portulacastrum*)..The larger area was covered with the non-native pickleweed (*Batis maritima*) with mangrove (*Rhizophora mangle*) growing around the fringes. No makaloa (*Cyperus laevigatus*) was seen in any of these wet areas on the south of the harbor in the project area.

The additional study on anchialine pools, which is discussed on pages 10 and 11 of this letter, identified the ‘akulili, pickleweed and mangrove, as well as makaloa in a single tuft.

Section 3.7.1.2 Flora, Anticipated impacts and Recommended Mitigations
The DEIS proposes to mitigate project impacts to coastal native flora, including culturally important species, by establishing a protected 400-foot strip extending back from the shoreline (page 34, paragraph 4), However, according to Appendix G, marina construction will cut off the freshwater flow necessary for these plants to survive (Appendix G, page 4, par. 2: “most of the trees will die off as well” as will “brackish water vegetation currently in anchialine ponds.”). Therefore a significant negative impact, as defined by HAR §11-200-12 B (1), to natural and cultural resources will result from the destruction of the water supply for these plant communities The DEIS does not discuss what water source will be provided to keep native vegetation in the 400-ft buffer. Non-potable water pumped from on site wells (proposed but not discussed in Section 3.8.2, page 40) and/or use of R2 or R1 water will each have significant impacts and consequences, and are not addressed in the DEIS.

Response: As discussed in this letter, additional studies conducted in response to DEIS issues indicate that DEIS information regarding the impact on anchialine pools due to changes in groundwater hydrology may be premature. Waimea Water Services found that harbor construction would cut off some of the fresher groundwater flow. However, predicting the extent of change in flow is difficult if not impossible even with numerous boreholes and intense sampling. The tides alone create a mixing system that increases salinity, as the flow approaches the point of discharge which will be either the channel or the shore. Another factor that could influence groundwater quality is the increased local recharge from irrigation between the channel and shore. This will add fresh water to the lens locally but is not quantified at this time.

Quantification of the changes in groundwater flow is extremely difficult. The shallow lavas are of the pāhoehoe type and have a relatively high horizontal permeability. In surface depressions or undulations, the pāhoehoe lavas have a tendency to lose vertical permeability from sedimentation thus restricting water exchange within the individual pools. This is normally reflected in both the salinity and temperature and this information has been adequately studied in anchialine pools.

Hence, the additional studies found that changes in groundwater quality may or may not impact biological communities in the shoreline environment.

The EIS has been revised to address your comments, as follows:

> It is not expected that flora located west of the proposed harbor will be significantly impacted by possible changes in groundwater conditions due to harbor construction. This area averages 13 inches of rain a year, much of which percolates down to the water table. Also the native coastal plants that grow in the sand and coral areas cast up onto the lava shelf by west swell surf are not likely to be affected at all. Further, the native plants growing on the coastal strip are all widespread enough that the creation of the coastal buffer strip should provide them adequate consideration and protection.

Section 3.7.2.1 Fauna, Existing Conditions
Although the endangered Hawaiian hoary bat (Lasiurus cinereus semotus) was not recorded during the two morning and two evening surveys in February 2006 (page 34, & Appendix E, pages 4-5), bats are known to utilize the Honokōhau Harbor and Kaloko-Honokōhau National Historical Park (See Parrish 2005. http://rprs.nps.gov/research/ac/search/iars/Iar?reportId=36354). A 2005 survey conducted between March and July by the NPS Inventory and Monitoring Program detected bats on four of 15 survey nights (3 surveys in April, 1 survey in May) feeding in the National Park and harbor. The length and timing of survey used in the DEIS to detect seasonal, highly mobile rare species is inadequate.

Response: Frank Bonaccorso,[1] and his team from the USGS conducted a three-year study of Hawaiian hoary bats, and how best to develop census techniques to arrive at quantitative data on their population size and distribution. They concluded that there is no practical method to conduct such surveys. What can be expected is a determination of presence or absence of the species using techniques similar to those employed by the fauna consultant on this project. On a grander scale, long term multi-unit sampling of bat pass activity now appears to offer a window into activity levels, but not population density.

It is clear that bats use resources within Kaloko-Honokōhau National Historical Park, and that they travel over the subject property. However, little more can be determined regarding densities. Another finding of the USGS survey is that the Hawaiian hoary bat is ubiquitous on the island of Hawaii in all areas that support trees and dense vegetation, and that the bat is a human commensal species. Thus the planting of landscape trees, ornamental vegetation

[1] *Bonaccorso, F. J., C. M. Todd and, A. C. Miles. 2005. Interim Report on Research to Hawaiian Bat Research Consortium for The Hawaiian Hoary Bat, Ope'ape'a, Lasiurus cinsereus semotus. 1 September 2004 to 31 August 2005*

and the presence of street lights associated with the development will likely enhance the foraging resources in the area for this species. Their research also indicates that the Hawaiian hoary bat maintains a significant population on Hawaii. Natural resource agencies have been discussing the steps that will be necessary to de-list this species at least in Hawaii, since it appears as if this islands population has increased to the point that de-listing may be indicated.[2]

Section 3.7.2.1 Fauna, Existing Conditions (continued)
The DEIS states (page 35 & Appendix E, page 10) that it is possible that the endangered, endemic Hawaiian petrel and the threatened Newell's shearwater fly over the project area between May and November. Yet properly timed surveys utilizing appropriate methodology for high-flying birds were not conducted to confirm flyover. Visual and aural surveys are not likely to be adequate to detect these species. Therefore the DEIS does not adequately assess the potential impacts to these protected species.

Response: As discussed on pages 9 and 10 of the survey of avian and terrestrial mammalian species, and summarized in Section 3.7.2.1, passage rates of these two species in the Kona area are low. Of more importance than the number of birds that flies fly over the site are the possible impacts of the development on these listed species, and what can be done to minimize or mitigate those impacts. The recommendations on page 11 of the aforementioned survey and as summarized in Section 3.7.2.2 are similar to those accepted by the US Fish and Wildlife Service (USFWS) and the State Department of Fish and Wildlife (DOFAW) on several projects on the island of Hawaii in the recent past.

Section 3.7.2.2 Fauna, Anticipated Impacts and Recommended Mitigations
The DEIS states (page 36) "Therefore, it is not expected that the development of the proposed Kona Kai Ola property will have significant impacts on native avian or mammalian resources present within the North Kona District." This statement is false and illustrates the lack of attention paid to all areas potentially affected by the proposed project activities, and the Cumulative Impacts section of the document (see comments on Section 8). Kaloko-Honokōhau NHP is adjacent to the project site and contains significant foraging and breeding habitat for the Hawaiian stilt (Himantopus mexicanus knudseni) and the Hawaiian coot (Fulica alai) (USFWS 1999, page 33). Introduced predators are described in the Draft Revised Recovery Plan for Hawaiian Waterbirds, Second Revision (USFWS 1999, page 25) as having a negative impact on waterbird populations. Site grading the project's 530 acres will remove vegetative and structural cover that provides habitat for alien predators (feral cats, mongoose, feral dogs, and rats). Most of these predators will move into the National Park lands, increasing predator pressure on the endangered water bird populations. The NPS has observed this large-scale immigration of predators following the extensive grading of400 acres at the neighboring Shores at Kohanaiki development. This direct and cumulative impact and its mitigation is not addressed in the DEIS.

Response: The proposed brackish water pond area at Kona Kai Ola will provide additional habitat for shorebirds and some visiting seabirds. In that Kona Kai Ola is in the planning stage, there is no detailed information of the configuration and other features. The following text is added to Section 3.7.2, Fauna, to respond to your comment:

> <u>The proposed brackish water pond area will provide additional habitat for shorebirds and some visiting seabirds. The creation of 19 acres of lagoons may result in impacts to two listed endemic waterbird species, including Black-necked Stilt (*Himantopus mexicanus knudseni*), and Hawaiian Coot (*Fulica alai*). It may also result in impacts to some</u>

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[2] ______. 2007. *Interim Report on Research to Hawaiian Bat Research Consortium for The Hawaiian Hoary Bat, Ope'ape'a,* Lasiurus cinsereus semotus. *April 1, 2007*

migratory shorebird and waterfowl species protected under the Migratory Bird Treaty Act (MBTA). While the increase of habitat will benefit these species, there is also a possibility that these species may be exposed to activity that may harm them.

The developer will consult with Kaloko-Honokōhau National Historic Park, DOFAW and USFWS to develop a plan to establish a managed ecosystem and mitigate any potential impacts to listed species resulting from development of this property. A Natural Resources Management Plan that covers all listed species likely to be impacted following the development of a more detailed development plan will be prepared and implemented.

The US Fish and Wildlife Service will be consulted under the Endangered Species Act, as well as the DLNR under HRS Section 195D.

Section 3.7.2.2 Fauna, Anticipated Impacts and Recommended Mitigations (continued)
The DEIS proposes providing additional habitat for endangered waterbirds (page 36). On site predator control must be a significant consideration in this proposal for the reasons stated above. Furthermore, consultation with the US Fish and Wildlife Service and DLNR Department of Forestry and Wildlife is not mentioned and is required as part of this proposal.

Response: Onsite predator control would be an integral part of the Natural Resources Management Plan. The project will consult with both the USFWS and DOFAW regarding potential impacts to listed species protected under federal and state of Hawaii endangered species statutes. The consultation with the USFWS will be under Section 7 of the endangered species act, of 1973, as amended, due to the need for ACOE permits. Consultation with the state will be under HRS 195D. The development will comply with all terms and special conditions resulting from those consultations.

Executive Summary, page vii and Section 10, Unresolved Issues
Groundwater
The source of water supply for the proposed project, 2.6 million gallons per day (Mgal/d), must be identified to be able to adequately assess project impacts to groundwater supply, flow to coast, and proximal environment. If local groundwater sources are tapped to meet the project demands, the DEIS is insufficient to address impacts. Old et al (1999) showed that groundwater flux to the coast along Kaloko-Honokōhau NHP has decreased by —50% and water levels throughout the National Park have dropped by -0.6 ft since 1978 in response to modest levels of withdrawal. The demand for this project requires much higher withdrawal levels. Saltwater intrusion into the local aquifers would be an irreversible, significant long-term adverse impact to the local ecosystem and future groundwater use.

Response: Oki and others (1999)[3] did not show a present 50% drop in groundwater flux in Kaloko-Honokōhau National Park. The groundwater model simulation that indicated a 47% decline in flow through the park used a projected pumping rate of 56.8 mgd in a series of wells distributed between Keahole Point and South Point. That simulated pumping rate of 56.8 mgd has not yet been reached in this area. The current pumpage in the Keauhou Aquifer System is about 11 mgd. Furthermore, the model was run to steady-state. Simulated steady-state conditions would not be reached for hundreds of model-years in a groundwater flow system as large and complex as west Hualalai.

The proposed project will use approximately 2.6 mgd when it is completed. The source wells will be located southeast of the project area. If we assume steady-state flow conditions, flow

[3] *Oki, D.S., Tribble, G.W., Souza, W.R., and Bolke, E.L. (Oki., D. S., Tribble, G. W., Souza, W. R., and E. L. Bolke, 1999).* Ground-water resources in Kaloko-Honokōhau National Historical Park, Island of Hawai'i, and numerical simulation of the effects of ground-water withdrawals. *Prepared for the U. S. Geological Survey Water-Resources Investigation Report 99-4070, p. 49. 1999.*

vectors perpendicular to the coast and also assume the source water wells will be distributed along a five-mile line parallel to the coast, then ultimately the 2.6 mgd withdrawal will result in a 2.6 mgd decline in groundwater flux along a five mile length of coast. Oki and others (1999) reported that groundwater flux in the area of the Park is about 3 mgd/mile. Based on this value the total flux in the five mile length of coast would be 15 mgd. Under these assumptions, flux along the five-mile length of coast would decline to a net 12.4 mgd. This would result in a 17% decline in groundwater flux through the Park. Note that this is under steady-state and these conditions will probably take hundreds of years to achieve.

Section 3.8.1.2 Groundwater Flow and Quality
The DEIS states "groundwater discharge occurs within a 20-foot thick layer just below the water table. . ." (page 39). However, the fact that the DEIS also states that groundwater with a "salinity of 34ppt (97 percent seawater) is found at a depth of 80 feet" (page 39), indicates that a component of fresh groundwater can still be found at a depth of at least 80 feet. Thus, a component of terrestrial-derived groundwater is discharging at a depth of at least 80 feet and not just within a 20- foot layer as stated. The DEIS also states: "Numerical modeling of the groundwater flow system quantified the overall recharge and discharge of groundwater throughout the shoreline, but did not have sufficient details for the Honokōhau area (Old, USGS 1999)" This statement is misleading. The authors of the DEIS are aware of the Old et al 1999 report titled "Ground-water resources in Kaloko-Honokōhau National Historical Park, Island of Hawaii, and numerical simulation of the effects of ground-water withdrawals," which specifically addresses the Honokōhau area.

Response: The high permeability of the ground in the area prevents the formation of a fresh groundwater lens. This results in a relatively thick brackish water transition layer. The driving force for the subsurface circulation comes from ocean tides and the density distribution of brackish water. The subsurface circulation moves less brackish water seaward and the lower more dense layers landwards. This circulation is described in the Oki report.

Although the Oki et al (1999) report specifically addressed the Honokōhau area, the numerical model used was a regional model and is not appropriate to simulate local groundwater flow.

Section 3.8.1.3 Groundwater Flow and Quality, Anticipated Impacts and Recommended Mitigations; and Appendix F, Geology and Ground-Water Hydrology in the Vicinity of Honokōhau Harbor
The DEIS does not provide the necessary data to describe or assess the environmental impacts to regional groundwater and to Kaloko-Honokōhau National Historical Park, whose cultural and natural resources are dependent on groundwater quantity and quality. Groundwater flow and quality are not sufficiently quantitatively studied in the document, therefore conclusions regarding groundwater in the DEIS are scientifically unsupported.

Response: Net groundwater flow in the region occurs from the higher elevations in the east to the ocean in the west. The larger subsurface circulation is driven by the ocean tides as reported by Oki. It is very unlikely that groundwater resources to the north of the existing harbor basin in the Park will undergo significant impacts from harbor construction to the south of the existing harbor basin.

Section 3.8.1.3 Groundwater Flow and Quality, Anticipated Impacts and Recommended Mitigations; and Appendix F, Geology and Ground-Water Hydrology in the Vicinity of Honokōhau Harbor (continued)
The DEIS states (Page 40): ". . ,because the proposed marina is to the south and does not extend as far inland as the existing harbor, any impacts to groundwater flow will likely be

limited to lands south of the existing harbor." No quantitative analysis of groundwater flow is provided in the DEIS to substantiate this conclusion. Furthermore, because groundwater can flow beneath the existing harbor bottom (see comment above re: page 39, terrestrial-derived groundwater is found at 80 feet depth), the excavation of the proposed harbor expansion can potentially affect groundwater flow to the north.

Response: It is not clear that groundwater can flow beneath the existing harbor bottom. Groundwater will tend to flow towards and into the harbor.

Section 3.8.1.3 Groundwater Flow and Quality, Anticipated Impacts and Recommended Mitigations; and Appendix F, Geology and Ground-Water Hydrology in the Vicinity of Honokōhau Harbor (continued)
There is confusion in the DEIS on groundwater flow and quantity. Page 45 (Section 3.9.1.3) states that "the proposed marina basin to the south will intercept additional groundwater, adding these flows to the existing harbor outflow." However, paragraph 3 on page 45 contradicts the previous statement: "Hydrogeological studies have concluded that the expansion of the marina does not increase the groundwater flux through the harbor mouth into the ocean significantly. The groundwater from the brackish aquifer already converges to the existing harbor and does not showflow across the planned marina basin area into the ocean."

The figure of groundwater flow (Appendix F, page 6) indicates that development of the new harbor facility may intercept groundwater presently flowing to the sea perpendicular to the groundwater elevation contours presented and increase groundwater flow through the harbor and its entrance to the sea. The depiction of groundwater flow directions in this figure are based on instantaneous measurements and also presume that the groundwater-level contours are accurate based on data from only six wells. Data should have been collected from other wells to refine the contours. Given the effects of ocean tides on water levels, average water levels over a specified time period would have provided a better picture of average conditions than instantaneous measurements.

Response: Instantaneous groundwater elevation measurements are more appropriate for characterizing groundwater flow in a complex tidally influenced system than average groundwater elevations. Average measurements would not address short-term variations due to tidal fluctuations. Six wells are more than adequate to identify groundwater flow direction. A minimum of three wells is required.

Section 3.8.1.3 Groundwater Flow and Quality, Anticipated Impacts and Recommended Mitigations; and Appendix F, Geology and Ground-Water Hydrology in the Vicinity of Honokōhau Harbor (continued)
Given the uncertainty in groundwater-flow directions, it is possible that contaminants originating in parts of the proposed development can enter the groundwater system and flow to flshponds and anchialine pools in the National Park. To properly address impacts, a refined analysis of groundwater flow directions is needed but not presented in the DEIS.

Response: We do not agree that there is extreme uncertainty in the groundwater flow directions. The groundwater flow direction was derived from field data. A refined analysis of flow directions would still have to account for actual field data.

Section 3.8.1.3 Groundwater Flow and Quality, Anticipated Impacts and Recommended Mitigations; and Appendix F, Geology and Ground-Water Hydrology in the Vicinity of Honokōhau Harbor (continued)
There is no mention in the DEIS of the subsurface geologic conditions in the vicinity of the proposed project, which likely includes lava tubes that transmit groundwater toward the

coast. Marina construction may change groundwater flow patterns in the vicinity, which can lead to changes in saltwater intrusion as well as changes in groundwater and nutrient flux to the nearshore environment. It is possible that well #6 may not currently be within the effluent plume from the WWTP and that creating the new basin could lead to elevated nutrient concentrations (relative to what was found in well #6) in groundwater discharging to the harbor. Unfortunately, water quality data from the other borings are not presented. The DEIS does not adequately address these issues to evaluate important possible impacts to water resources and to the nearshore ecosystem.

Response: Based on the available groundwater data, the Harbor Water Quality Monitoring Study included a simplistic analysis to determine the effect of the WWTP effluent on the groundwater entering the harbor currently, and its effects on the groundwater flowing into the new harbor (Appendix C of Appendix U).

It was found that groundwater had minimal effects on the conditions of the brackish groundwater entering Honokōhau Harbor currently, and a large effect in the region of Well #6, the location of the new harbor. This indicates that Well #6 is likely within the WWTP effluent plume currently. The planned upgrade of the WWTP to tertiary treatment and elimination of groundwater injection will eliminate the elevated nutrient concentrations due to the WWTP, and the inflow to the new Marina is expected to have similar nutrient concentrations to the inflow currently entering Honokōhau Harbor. In the water quality model, the groundwater entering the new harbor was specified to maintain the quality that is currently experienced due to the planned upgrade to the WWTP.

Section 3.8.1.3 Groundwater Flow and Quality, Anticipated Impacts and Recommended Mitigations; and Appendix F, Geology and Ground-Water Hydrology in the Vicinity of Honokōhau Harbor (continued)
Although Appendix F (page 12) concludes that the "Honokōhau Harbor is the dominant drainage point with the groundwater flowing from the lands of the Kaloko-Honokōhau National Park and from the vicinity of the Queen Ka 'ahumanu Highway," no quantitative analysis of the effects of the harbor expansion on groundwater flow through the National Park is provided. If it is true that groundwater originating in the Park discharges to the existing harbor, expansion of the harbor may increase the likelihood for groundwater originating in the Park to discharge to the harbor area rather than continue to flow to coastal flshponds and anchialine pools in the Park. These ecosystems are dependent upon groundwater flow and quality. The DEIS dose not contain the necessary analyses to assess this impact, to quantify the change in groundwater flow to the Park's flshponds and anchialine pools, and to determine how salinity of groundwater in the Park might be affected.

The contention that the high tidal efficiency in well #6 indicates "that there would be very little change f the rock were absent" (Appendix F, page 10) is insufficient because (1) the existing rock must offer some resistance to flow, and (2) the geometry of the groundwater system will be altered by excavation of the harbor. Furthermore, no tidal data are provided to support the statement that the "the tidal efficiency is nearly 100%" (Appendix F, page 10) in well #6.

Response: The existing Honokōhau Harbor is a drainage point for groundwater flowing south from the Kaloko-Honokōhau National Park. The proposed expansion of the harbor will be south of the existing harbor and will not affect the existing groundwater flow patterns from the park.

Section 3.8.1.3 Groundwater Flow and Quality, Anticipated Impacts and Recommended Mitigations; and Appendix F, Geology and Ground-Water Hydrology in the Vicinity of Honokōhau Harbor (continued)
Water temperature values for monitoring wells (table on page l4, Appendix F) range from

30.5 to 34.2°C. These temperatures appear high and are not consistent with values indicated on pages 11-12 of Appendix F.

Response: These temperature measurements were taken in the laboratory and do not indicate field conditions.

Section 3.8.1.3 Groundwater Flow and Quality, Anticipated Impacts and Recommended Mitigations; and Appendix F, Geology and Ground-Water Hydrology in the Vicinity of Honokōhau Harbor (continued)
Appendix F refers to well #2, well #2A, and well #6. Why are water levels or water-quality data from other wells that were drilled as part of the proposed development not presented (Section 3.8.1, Figure M, page 38,)?

Response: The other borings were for geotechnical purposes and were not intended to be converted to water level monitor wells.

Section 3.8.2 Surface Water.
The DEIS does not adequately describe the environmental impacts from stormwater runoff to the marina and no innovative, sustainable ("green") stormwater best management practices or other measures to mitigate these impacts are provided in the proposed drainage system for the project (see comments on Section 4.10.5, Drainage and Storm Water Facilities). The DEIS claims (page 40) average rainfall on site is 13 inches a year. However, page 26 cites a NOAA 2006 source of average annual rainfall as 15-20 inches, which could not be located at the website cited. The Rainfall Atlas of Hawaii (Giambelluca et al. 1986, Appendix Figure A.66) provides the range (averaged over 30 years) as 19.6 to 29.5 inches a year. Planning for retention of runoff during high rainfall events is critical. Surface water retention on site should take into account at the minimum a 10-year storm event. The meaning of "complete retention" (page 41) of the 1-year 24-hour rainfall runoff is unclear and misleading. It is uncertain as to whether complete retention is meant to imply that the runoff would never enter the ocean. It will certainly enter the groundwater through the drywells (simple holes in the ground with no cleansing abilities), which will ultimately enter the harbor and nearshore waters. Evaluation of "complete retention," its feasibility, and the procedures to obtain "no run-off," cannot be made with the information provided in the DEIS. In addition, the DEIS misleadingly implies that 3 inches of rain in 24 hours is insignificant (page 40), ignoring the importance of the rate of rainfall. For example, on February 1,2007, more than 3 inches in 3 hours (4.37 inches of rainfall in 24-hr) fell in the project area, causing significant sheet- flow surface runoff to the harbor waters (NPS RAWS rainfall data, NPS staff observation).

Response: Information regarding rainfall has been revised as indicated on pages 25 and 26 regarding our response to your comments on natural drainage, and the following is revised text in Section 3.8.2, Surface Water regarding a one-year 24-hour storm:

> Precipitation from moist higher elevations percolates rapidly due to high permeability of the natural ground surface. No natural gulches or waterways for surface run off have been formed. The site receives an annual average of only 13 inches of rainfall a year. A one-year 24-hour storm delivers only 2 to 2.5 inches of rainfall (Giambelluca, etal 1986).

As indicated in our response to your comments on natural drainage, the drainage system for Kona Kai Ola, which is summarized in Section 4.10.5, Drainage and Storm Water Facilities, will meet current County of Hawaii drainage standards and include measures to handle stormwater. Specific measures related to retention of stormwaters will be detailed in applications for an Underground Injection Well Permit from the Department of Health and a National Pollutant Discharge Elimination System permit.

Section 3.8.2 Surface Water.
This section lists "brackish well water" (page 40, par. 7) as a source for irrigation of planted areas, but no other mention or discussion of impacts from on-site wells to groundwater quantity and quality are discussed in the DEIS.

Response: It is expected that local freshwater recharge from landscape irrigation and storm water disposal will supply adequate local recharge for a limited number of on-site brackish water irrigation wells.

Section 3.9 Marine Environment and Aquatic Ecosystems
Section 3.9.1.1 Existing Conditions, Nearshore Environment and Coastal Waters
On page 43 the DEIS states that "Currently 3 to 4 mgd of brackish water with salinities of about 5 ppt flow through the existing harbor into the ocean." On page 45 it states that "the salinity of the water that discharges from the brackish aquifer is ... about 4.3 parts per thousand ppt)." However it also states in the following paragraph on page 45 that "At present the depth averaged salinity of the water exiting the existing basin is about 33.5 ppt close to the marina entrance." (Surface water of 33.5 ppt is shown in Figure 4 in Appendix H and appears to be accurate). Not only are these statements conflicting (4.3 ppt v 5.0 ppt) but they are also unnecessarily confusing to the lay-reader, first suggesting that the salinity of the water exiting immediately into the ocean is very low, 5 ppt, and then stating that the water exiting the harbor into the ocean is 33.5 ppt. The DEIS does not explain without contradiction that at present the water exiting the harbor into the ocean is about 33.5 ppt.

Response:

The Harbor Water Quality Modeling Study, as contained in Appendix U discusses the brackish groundwater flow into Honokōhau Harbor. An extensive model calibration effort was dedicated to determining this value. This effort is summarized in Appendix G-1, Geology and Ground-water Hydrology in the Vicinity of Honokōhau Harbor, and is further detailed in Appendix B of Appendix U. The salinity contours at the back of Honokōhau Harbor indicate that the majority of the brackish inflow to the system originates at the back of the harbor. Using the contours reported by OI Consultants[4] and Glenn [5] and the flushing time analysis described in detail in OI Consultants, it was found that, to obtain the contours and flushing described, about 30 mgd of 22 ppt water enters through the back wall of the harbor. While it is noted in other sections that this value varies seasonally and with the tide, it is sufficient for the typical conditions represented by the model to use a constant input value.

Using this value it is much easier to see that a value of 22 ppt can easily mix to a value of 33.5 ppt by the time that it exits Honokōhau Harbor.

Section 3.9.1.2 Methodologies and Studies, Nearshore Environment and Coastal Waters
The bathymetric data used for models and for general discussion about impacts lacks the resolution requisite for 'best possible' interpretations. Many processes (waves, vertical mixing, dispersion of nutrients) are strongly dependent on the depth and morphology of the nearshore zone. The lack of high-resolution bathymetric data in the DEIS affects the validity of many statements and findings (page 43, paragraph 6).

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[4] *OI Consultants, Inc., "A Study of Water Quality and Plankton Population at Honokōhau and Kawaihae Harbors-Spring 1991" contained in Studies of Water Quality Ecology, and Mixing Processes at Honokōhau Harbors on the Island of Hawaii, prepared for Mauna Lani Resort, Inc., 1991.*
[5] *Glenn, Craig R. (2006). "Collaborative Research: Assessment of Groundwater Inputs into Coastal Waters of Hawaii via Natural Tracers and Aerial Imagery," NSF Annual Report # 0451379*

Response: The study models used to study nearshore and coastal waters are appropriate. The bathymetric data used for the hydrodynamic and water quality modeling effort was created using data collected by the SHOALS (Scanning Hydrographic Operational Airborne Lidar Survey) system to a depth of -30 m. At the harbor the bathymetry was created using the available navigation chart. Offshore areas were constructed from surveys collected by the National Oceanographic Service (NOS) of NOAA and available via their GEODAS system.

Section 3.9.1.2. Methodologies and Studies, Nearshore Environment and Coastal Waters (Appendix G: Water Quality and Marine Biological Baseline Studies and Impact Analysis)

There are several inconsistencies in Appendix G. Water quality measurements were collected over 3 days during a 12-day (not 14-day as reported) time period in April, 2006 (page 8). Locations in Figure 2 do not correspond with descriptions in text. Transect A is offshore of Kaloko Fishpond; Transect B is offshore of Aimakapa Fishpond. Figure 11 apparently also represents the transect locations inaccurately. For example, as drawn, transects B, C, D, and E; would end in less than 10 m of water vs. -20 m as stated in report.

The water quality and marine biological baseline studies (Appendix G) are each unsatisfactory in their sampling design and sampling effort, and therefore lack the statistical power to meet the stated objective to "quantitatively describe existing water quality and biological community conditions... . "The DEIS studies cannot a) reliably characterize present conditions and b) serve as the baseline study to reliably detect future changes in benthic habitat, fish populations, and water quality originating from the development.

Response: We note that Appendix G has been re-designated Appendix H-1.

Your observation on the survey period is correct. The time of the sampling project was from April 1 to April 14, 2006. The 14 days period refers to this period. However, the first sampling event took place on April 3 and the last on April 14.

Figure 2 of Appendix H-1 shows the location of water quality monitoring survey transects at the Kona Kai Ola project site. The transect locations are described as "Two transects were located north of the Honokōhau Harbor entrance, off the Kaloko-Honokōhau National Historic Park; two transects were located south of the harbor entrance between Noio and Kaiwi Points; a fifth control transect was located off Keahuolu". These descriptions are related to Figure 2, which is not drawn to scale. The text also describes sampling locations as "Water samples were collected at distances of 1, 10, 50,100, and 500 meters from the shore". The transect shows the location and the length is not indicative of distance or water depth because the figure is not to scale.

As described in Appendix H-1, the objective of the study was to conduct water quality and aquatic habitat baseline surveys in support of the proposed Kona Kai Ola at Kealakehe (KKO) development. The results of the surveys will be used in support of a Master Development Plan, a Core Infrastructure Plan, an Environmental Impact Statement, General Plan Amendment, Change of Zoning Request, Special Management Area Use Permit, Conservation District Use Permit and the Department of the Army Permit.

The analysis focused on the water quality and biological communities within Honokōhau Harbor, in the coastal waters along the Kaloko-Honokōhau-Kealakehe coastline, and anchialine ponds. The overall intent of the surveys was to quantitatively describe existing water quality and biological conditions and to identify potential impacts to these resources due to proposed development. We disagree with your comment that the studies are unsatisfactory. The study is not intended to be used as a baseline study for future monitoring of changes in the benthic habitat and fish populations as indicated in your comment.

Section 3.9.1.2. Methodologies and Studies, Nearshore Environment and Coastal Waters (Appendix G: Water Quality and Marine Biological Baseline Studies and Impact Analysis) (continued)
Furthermore, the proposed development may have a negative impact on marine communities. Therefore the DEIS needs to explicitly state (a) what level of change would be considered 'normal' or 'acceptable' either relative to the existing condition or to an appropriate set of control sites; and (b) what minimum spatial scale of impact would be detectable based on the surveys in Appendix G.

Response: The potential impacts on marine communities are the result of land use changes that may impact groundwater and eventually the nearshore waters. These potential impacts may include sediment plume from the harbor when the berm separating the new marina is removed at the end of excavation, and additional groundwater discharge through the harbor entrance due to expanded harbor area.

The impacts from groundwater and surface runoff into the marina and finally to the nearshore waters are likely to be small because groundwater is less dense than ocean water and will float on the surface. In addition, the three dimensional water quality model analysis of conditions before and after harbor construction scenarios showed that, if the existing two layer flow in the harbor is maintained, most of the groundwater and surface water will be confined to the layer close to the surface and the water quality of the bottom layer that comes into contact with benthic communities will be clean ocean water. The water quality analysis study is attached as Appendix U.

The study is not intended to predict explicitly the levels of change acceptable or the minimum detectable spatial scale impact. Such a study will have to be conducted multiple times over a long period to understand the natural community variations from seasonal and other species specific properties, as well as natural variations in density and diversity of communities under different conditions. As discussed earlier, the study was conducted to assess the existing community and water quality conditions and potential impacts and mitigation.

Section 3.9.1.2. Methodologies and Studies, Nearshore Environment and Coastal Waters (Appendix G: Water Quality and Marine Biological Baseline Studies and Impact Analysis) (continued)
Coastal Benthic Biota
Appendix G does not cite the recent benthic habitat mapping studies by the USGS, Gibbs et al., (in press). Although it is "in press," the DEIS authors were aware of the mapping and its availability.

Response: Section 3.9.1.1, Existing Conditions, has been revised to incorporate data releases by USGS in 2007, as follows:

> The USGS (2007) has recently completed a benthic habitat survey of the waters off shore of the Kaloko-Honokōhau National Historical Park and fronting the Honokōhau Harbor. This study has identified 21 separate benthic habitat classes, the distribution of which is primarily controlled by the character of the submerged volcanic flows. Twelve habitat zones are identified which are controlled primarily by water depth, benthic slope, and substrate structure. The dominant structure is a large shallow bench between the shoreline and extending up to 700 meters off shore where it ends in a shallow escarpment. Coral cover is highly variable over the entire submerged park area, but some of the highest coverage is located to the north and south of the harbor channel

entrance. This study identifies an area at a depth of about 10-15 meters (~40 feet) off the harbor mouth with lower than expected coral cover.

Section 3.9.1.2. Methodologies and Studies, Nearshore Environment and Coastal Waters (Appendix G: Water Quality and Marine Biological Baseline Studies and Impact Analysis) (continued)

Although the DEIS states that "Coral communities within the Honokōhau Bay and off the Kona Kai Ola site area generally typical of West Hawai'i reefs, with little evidence of anthropogenic impacts." (Appendix G, page 2; DEIS page 41) Diver/snorkeler/fishing related impacts to reefs, especially close to shore and around mooring buoys, were apparently not evaluated. The DEIS states: "Highest coral abundance was observed at locations immediately to the north and south of the Honokōhau Harbor entrance channel. Coral cover at locations north and south of these were not statistically significantly different; however, reefs to the north of Honokōhau Harbor in general showed higher coral cover than reefs to the south, primarily because the southern reefs are more exposed to strong surf and associated damage and scour." (Appendix G, page 2) We concur that coral cover is highest directly north and south of the harbor mouth (e.g. transects D and E), however, a relatively large area of low to very-low coral cover exists between these two transect locations, directly seaward of the entrance channel, and in water depths greater than 12 m. The causes of this degradation are unclear. Hypotheses include high bottom stresses associated with tidal currents, the passage of boats, or natural focusing of flow on and off the adjacent shallow platforms, increased sedimentation, and/or water quality differences, including variations in salinity, temperature, and/or water chemistry resulting from the existing harbor.

Response: The marine biological study was conducted to assess existing conditions, to identify potential impacts and to develop mitigation to minimize these impacts. The proposed site development or marina development and availability of additional slips for commercial activities may increase diving, fishing and snorkeling. To mitigate adverse impacts the industry has to be regulated more strictly. At these dive and snorkeling sites, impacts are more related to localized commercial activities and were not evaluated in the larger scale impact assessment. We agree that the coral cover in the approach channel is lower that on the sides, however, the study did not find any direct causes for the low coverage.

Section 3.9.1.2. Methodologies and Studies, Nearshore Environment and Coastal Waters (Appendix G: Water Quality and Marine Biological Baseline Studies and Impact Analysis) (continued)

Appendix G, page 2, par. 4 states: "Water depths at the shoreline are 3-5 m, or deeper." [emphasis added) This statement is incorrect, and is misleading as to the potential impacts to the surrounding benthic community. Over 800 km2 (200 acres), or about 1/3 of the marine area of the National Park consists of shallow intertidal (0 m) to -5 m (Mean Low Low Water) depths, Noio Point and southward is the only area in the National Park where the water depth at the 'shoreline' immediately drops off to around -3 m (Based on lidar bathymetry and habitat mapping; Gibbs et. al in press).

Response: There is some confusion in the units used in this comment. One square kilometer is about 250 acres. 800 square kilometers is approximately 200,000 acres or 312 square miles. The length of the seaward boundary of the Kaloko-Honokōhau National Historical Park is approximately 24,000 feet or 7.5 kilometers. The area mentioned in the comments should extend out to sea over 100 kilometers. We cannot provide a response to this comment because the area mentioned in the comment extends beyond the project area.

Section 3.9.1.2. Methodologies and Studies, Nearshore Environment and Coastal Waters (Appendix G: Water Quality and Marine Biological Baseline Studies and Impact Analysis) (continued)

Appendix G, page 2, par. 4 states: "The discharge of brackish water from Honokōhau Harbor also does not appear to have impacts coral in the immediate vicinity; in fact, coral abundance is greatest at the two transects located immediately north and south of the entrance channel. "This statement is misleading and is not supported due to lack of transects across degraded zone off the harbor mouth.

Additionally, the DEIS does not include a discussion of potential impacts to other marine invertebrate communities (e.g. intertidal) and there is no discussion of potential impact to the octocoral, which is abundant in shallow water.

Response: Model analysis conducted for the Harbor Water Quality Study showed that under existing conditions, there is a two layer flow structure in the harbor basin. Existing salinity profile data for the harbor also further indicate the existence of this two layer flow. The less dense upper layer flows towards the ocean all the time and the bottom layer continuously flow into the marina from the ocean. Nutrients are contained in the upper layer of brackish groundwater. This does not come into contact with the benthic area. The degraded coral zone in front of the harbor mouth is not likely due to outflow from the harbor. Therefore, as long as the two layer flow is maintained, the impact of the development on the corals is expected to be minimal.

The Harbor Water Quality study was conducted to assess the impacts of the proposed project on the harbor and the marine environment. The study report is included as Appendix U of this EIS and is attached to this letter. The study found that with Alternative 1, in which a 25-acre marina is proposed, a two layer flow structure similar existing conditions will be maintained. The nutrient rich water flowing out of the harbor is limited to the upper less dense layer and the bottom layer is essentially clean ocean water. The corals and benthic community will not be exposed to higher nutrient concentrations, and the impact on these communities, including special species mentioned in the comment, therefore is minimal.

Section 3.9.1.2. Methodologies and Studies, Nearshore Environment and Coastal Waters (Appendix G: Water Quality and Marine Biological Baseline Studies and Impact Analysis) (continued)
Appendix G, page 2, par. 6 states: "... a pulse of sediment may be discharged when the berm is removed." It is unclear how much sediment is predicted and whether the proposed silt curtains are adequate for the amount. This sediment could be an adverse impact to the corals, especially the high coral cover areas immediately adjacent to the harbor. The DEIS does not explain how additional sediment would be controlled in subsequent marina build out phases (see comments on Section 1.6.4).

Response: The excavation of the marina will be separated from the ocean until the final break through the lava barrier at the sea end of the marina. The water in the marina will not be in direct contact with the ocean until the barrier is removed. The suspended sediment in water in the confined area will be left for some time to settle out the fines before breaching the barrier. A silt curtain will be installed on the sea side of the barrier and the breaching will be timed for ebb tide. Silt curtains have been used successfully to contain suspended solids in Kalaeloa Deep Draft Harbor construction where water depth is 30 feet. The silt curtains can be used effectively in the construction of the marina. A system of silt curtains will be used to contain suspended sediments within the construction area when facilities inside the marina are constructed. A Water Quality Certification Permit from the State Department of Health is required for the construction, and containment of the sediments within the work limits is a requirement of this permit. In addition to silt curtains, other Best Management Practices (BMPs) will be used to prevent pollutants from contaminating adjacent water and land areas.

Section 3.9.1.2. Methodologies and Studies, Nearshore Environment and Coastal Waters (Appendix G: Water Quality and Marine Biological Baseline Studies and Impact Analysis) (continued)
The Coastal Benthic Biota survey in Appendix G is insufficient in the following areas:

1. Transect placement is inappropriate. Benthic surveys were conducted at nine sites (3 depths per site), which are spread over approximately 4.5 miles of coastline, including points up to 2.2 miles north of the harbor mouth. However, the most severe nearshore impacts due to harbor construction would presumably occur at shallow sites north and south of the harbor mouth, around Noio Point, and in adjacent National Park waters. If the study is intended to meet its objective of serving as a quantitative baseline for detection of future impacts, then it is not adequate to detect impacts at this spatial scale and transects should have been concentrated in the areas most likely to be impacted. Additionally, the lack of transects in the harbor mouth area resulted in incomplete or erroneous conclusions regarding coral cover directly offshore of the harbor mouth (NPS data, Gibbs et al. (in press).

Response: The studies focused on the water quality and biological communities within Honokōhau Harbor, in the coastal waters along the Kaloko-Honokōhau-Kealakehe coastline, and anchialine ponds. The overall intent of the surveys was to quantitatively describe existing water quality and biological conditions and to identify potential impacts to these resources due to proposed development. We disagree with your comment that the placement of transects is inappropriate. Transects should be placed in such a way as to include areas of different benthic habitat and coral reef characteristics. Results of the survey shown in Table 9 of Appendix H-1 indicate that selected transects include areas with high coral cover (transect E and transect D), medium coral cover (transect B, transect F, transect H and transect B) and poor coral cover areas (transect A, transect C, and transect G). In addition, transects are geographically distributed across the project area. The study is not intended to be used as a baseline study for future monitoring of changes in the benthic habitat and fish populations. The report notes that the highest coral abundance was observed at locations immediately to the north and south of the Honokōhau Harbor entrance channel.

Section 3.9.1.2. Methodologies and Studies, Nearshore Environment and Coastal Waters (Appendix G: Water Quality and Marine Biological Baseline Studies and Impact Analysis) (continued)
2. More than one control site, with more than one transect describing each depth habitat, was not included in the study. A single control is statistically inadequate. Should some natural or anthropogenic impact occur on the single control site's small area, the control is useless for the purposes of monitoring this project.

Response: The study is not intended to be used as a baseline study for future monitoring of changes in the benthic habitat and fish populations study. The overall intent of the surveys was to quantitatively describe existing water quality and biological conditions and to identify potential impacts to these resources due to proposed development.

Section 3.9.1.2. Methodologies and Studies, Nearshore Environment and Coastal Waters (Appendix G: Water Quality and Marine Biological Baseline Studies and Impact Analysis) (continued)
3. The study methodology does not state how transect locations were selected. If transects were not selected randomly, the results only characterize the transects and cannot be extrapolated to larger areas.

Response: Please refer to our response to your first point.

Section 3.9.1.2. Methodologies and Studies, Nearshore Environment and Coastal Waters (Appendix G: Water Quality and Marine Biological Baseline Studies and Impact Analysis) (continued)

4. The number of transects per site and habitat are insufficient to establish the baseline conditions. With the existing sampling design for the DEIS, mean coral cover of 25.9% at transect H was not significantly different from 50.3% coral cover at transect D (Appendix G, page 43, Table 10). Ecologically, and in terms of any future impacts of development, 50.3% and 25.9% represent a substantial difference in coral cover. The sampling regime probably cannot distinguish those two because there is only one sample per depth at each site. Recent NPS studies to determine required number of transects to establish baseline showed that a minimum of 10 randomly selected, 10-m permanent photo-transects per depth habitat within each site are necessary to reliably characterize coral cover on the reefs in the National Park. Fewer transects result in unacceptably high standard error and the inability to reliably compare sites or to detect change in the reef over time. Coral cover variability recorded at shallow depths in Appendix G (mean 28.7 ± 13 SD) are almost identical to the coral cover found at similar depths used in the NPS study (mean 28.1 ± 13 SD, NPS data). In Appendix G, the variability was greater at the "mid" and "deep" depth zones. Therefore, it is reasonable to estimate that to establish a baseline for the proposed development, the study design should have included a <u>minimum</u> of 10 randomly selected, permanent transects per habitat per site (i.e., if 3 depth habitats are monitored, 30 transects should have been monitored at each site, more for higher variability as in the "mid" and "deep" zones).

<u>Response:</u> The study is not intended to be used as a baseline study for future monitoring of changes in the benthic habitat and fish populations study. The overall intent of the surveys was to quantitatively describe existing water quality and biological conditions and to identify potential impacts to these resources due to proposed development and propose mitigation measures where necessary. Transect lines were located in areas representing locations of distinct bottom habitat types such as boulder, reef bench, reef slope at depths 3 to 5 m, 8 – 12 m, and 15 – 20 m. respectively. We agree that a well defined baseline for monitoring benthic conditions need to consider all statistical aspects you have indicated. A long term monitoring project should have the resolution to identify spatial and temporal variations and long term trends that may occur. This would need implementation of a well designed program and is beyond the scope of this project.

Section 3.9.1.2. Methodologies and Studies, Nearshore Environment and Coastal Waters (Appendix G: Water Quality and Marine Biological Baseline Studies and Impact Analysis) (continued)

5. This DEIS study also cannot be used as the basis for future monitoring, because it has little chance of detecting changes (i.e. the study has low "Power") in coral cover due to low numbers of transects. Using the Appendix G data for mid-depth transects, we constructed a model to calculate the power of the study at varying alpha levels, lengths of time, and changes in relative coral cover (Skalski 2005; Table 1 below). Results, using DEIS data show that there is only a 12.7% chance of detecting change in coral cover over a 5-yr period even if the relative coral cover changes by 50% (c = 0.05). For example, if coral cover dropped from 50% to 25% in 5 years, this study only has a 12.7% chance of detecting that change. Over a 25-year period there is only a 23.9% chance in detecting a relative 50% change in coral cover.

Table 1: The ability to detect change (i.e. Power) in coral cover at mid depth transects using the harbor study design (N=9, one-tailed test). Because coral cover baseline data only occurred once, power estimates were made with best estimates of temporal variance and measurement error. Data for a second sampling period was created by reducing relative coral cover at each 10 m transect by 10%.

Relative Change in coral cover	Power to detect change at different levels across different time periods				
α=0.05	***5 yrs***	***10 yrs***	***15 yrs***	***20 yrs***	***25 yrs***
10%	0.071788	0.092361	0.103573	0.105068	0.106393
25%	0.10695	0.114864	0.121963	0.128586	0.136087
50%	0.0126679	0.157546	0.184683	0.212068	0.238778
α=0.10					
10%	0.142944	0.183106	0.204981	0.20693	0.208636
25%	0.210878	0.220881	0.230014	0.238406	0.247967
50%	0.241249	0.278896	0.312129	0.344535	0.375515

Total coral cover can be recorded with low measurement error and undergoes little natural temporal variability compared with fish surveys or water quality parameters. Therefore, the marine "baseline" study has even less ability to detect change in fish communities and water quality than shown on Table 1.

Response: The DEIS study was not intended to be the first of a monitoring program to identify impacts on benthic resources in Honokōhau Bay. The overall intent of the surveys was to quantitatively describe existing water quality and biological conditions, identify potential impacts to these resources due to a specific proposed development, and propose mitigation measures where necessary. Public agencies, such as the National Park Service and National Oceanic and Atmospheric Administration, have policies and objectives that extend beyond a single project and would more appropriately develop and implement a monitoring program for benthic resources in Honokōhau Bay. The developer will be wiling to participate in these efforts.

Section 3.9.1.2. Methodologies and Studies, Nearshore Environment and Coastal Waters (Appendix G: Water Quality and Marine Biological Baseline Studies and Impact Analysis) (continued)

Coastal Fish Communities

The fish survey program is insufficient. Because there is substantial natural variability in fish communities they can be difficult to adequately characterize. However, given that the proposed development will lead to increased fishing pressure and potentially cause habitat degradation, negative changes in the fish community are possible. Most of the points discussed in the section above (Coastal Benthic Biota) also apply to the fish study. In addition, this survey contains almost no information on current abundance of primary fishery targets such as jacks, parrotfish, and emperors (Table Dl and D2). Although 36 goatfish were counted on transects E south of the harbor mouth, NPS staff regularly observe several hundred goatfish at the harbor mouth. A single 25-rn long transect could easily yield counts of anywhere between 0 and 300 goatfish depending on the exact location and timing of any survey. These criticisms are not unique to this DEIS study, but a single 25-m fish transect at each depth zone is little more than semi-quantitative listing of the most common species; hence scientifically and statistically inadequate for the purposes of the DEIS. Power analysis was not performed to examine the ability of the study to reliably establish a baseline and to detect change in fish species and biomass. If these are unrealistic considerations, the limitations of the fish surveys should have been acknowledged. Additionally no attempt was made to reference existing, extensive fish-assembly time series data available from the Hawaii DLNR Division of Aquatic Resources.

Response: The surveys are intended to quantitatively describe existing water quality and biological conditions and to identify potential impacts to these resources due to a specific proposed development and propose mitigation measures where necessary. The surveys were conducted to document fish census within 4 x 25 meter transect areas up to the water surface. These single surveys might not encounter numbers and variety of fish that would be encountered in ongoing or regional surveys that may be conducted by the National Park Service.

Section 3.9.1.2. Methodologies and Studies, Nearshore Environment and Coastal Waters (Appendix G: Water Quality and Marine Biological Baseline Studies and Impact Analysis) (continued)

Water Quality

The water quality baseline study uses an inadequate sampling design and also does not constitute a true baseline, but merely a single, discrete snapshot in time. Numerous published studies throughout Hawaii, including more than one hundred thousand observations made in Kaloko-Honokōhau NHP by the NPS and the US Geological Survey (USGS), show that water quality parameters vary significantly through time. Thus, the temporally limited sampling scheme used in this study does not approach the need for accurate characterization of the water quality in or around the National Park and does not come close to approximating an adequate baseline.

Response: Water quality studies were conducted to determine the current condition of within the Honokōhau Harbor, the proposed project site, and at sites potentially impacted by the Kona Kai Ola Development. The studies state that water quality conditions along Hawaiian coastlines are influenced by a range of factors, including tidal exchange, surface discharge from surrounding lands during heavy rainfalls and groundwater. To characterize water quality conditions, 3 surveys were conducted within a 12-day period. Although data provides spatial coverage, it does not provide temporal coverage over a climactic cycle. Regular sampling in a spatially defined grid over at least one year and analysis using log normal analysis is required to establish a water quality standard. The State of Hawaii has established water quality standards for all oceanic waters surrounding the State of Hawaii. Marine waters of Honokōhau Bay, and offshore of Kona Kai Ola site to the south of Noio Point are classified as CLASS AA. Waters within the Honokōhau Harbor is classified as CLASS A. The water quality analysis results from the study were compared with the State standards to assess degree of impairment. These data were also analyzed to assess the existing impacts to water quality from discharge from the harbor and shoreline. Salinity is a good indicator of ocean influence and silicates are an indicator of groundwater influence. Inter relationships between these parameters were evaluated to determine the existing impact and to determine potential impacts from development. This information provides a reliable baseline for assessing project impacts and evaluating appropriate mitigation.

Section 3.9.1.2. Methodologies and Studies, Nearshore Environment and Coastal Waters (Appendix G: Water Quality and Marine Biological Baseline Studies and Impact Analysis) (continued)

The DEIS states that ". . .guidelines established by the West Hawaii Coastal Monitoring Task Force were followed in water sampling and analysis procedures (WHCMTF 1992)." (Page 43). According to a 2006 review of coastal monitoring data for developments in West Hawaii contracted by the County of Hawaii (Wiegner et al. 2006), these 1992 guidelines are outdated and "need to be revised, amplified, [and] enhanced. .."

The methodology for collecting the near-bed samples was not detailed and thus it is not clear how representative the samples are for a given cross-shore location and water depth (Appendix G, page 8). The stated methodology is conflicting and lacks adequate detail. Table 1 states Niskin bottles were used, which are appropriate, however text states in *several places (Appendix G, page 8) that water samples were collected directly into polyethylene bottles. It is well known that suspended particulate matter is under-sampled by collecting them directly into bottles due to turbulence induced by hydrodynamic friction at the mouth of the bottle (this is why Niskin bottles are used); the concentrations presented in the report likely do not accurately characterize those in the National Park and surrounding waters.*

Report: The 1992 report provides valuable data developed by the West Hawaii Monitoring Task Force, which included scientists from National Marine Fisheries, University of Hawaii Sea Grant - West Hawaii, US Fish and Wildlife Service, US Corps of Engineers, State of Hawaii Department of Health, Coastal Zone Management Program, Division of Aquatic Resources for Department of Land and Natural Resources, Institute of Marine Biology – University of Hawaii, University of Hilo – Geology/Oceanography, County of Hawaii Planning Department and other private consultants. The document addresses most aspects of coastal sampling. Whether the guidance document is outdated or not is a matter of opinion.

The comment indicates that there is confusion on the method of water sample collection. In this study, all water samples except those from the surface, were collected using 5-liter Niskin bottles as shown in Table 1 of Appendix H-1. Surface samples were collected directly into polyethelene bottles because it is not possible to successfully collect surface samples with Niskin Bottles.

Section 3.9.1.2. Methodologies and Studies, Nearshore Environment and Coastal Waters (Appendix G: Water Quality and Marine Biological Baseline Studies and Impact Analysis) (continued)

The report does not describe tidal conditions during the sampling periods for anchialine pools and marine waters, and is vague about strength of wind/surf condition (Appendix G, page 13). Thus it is unclear what conditions these measurements may characterize. Past work in the National Park has shown that groundwater effluence is typically greater at low tides and vertical mixing is greater during strong winds.

It is likely that potential high variability and relatively low number of samples may cause the power to be too low for 3-way ANOVA results to be reliable. Low statistical power means that the study design lacks the ability to reliably detect differences between sites or change over time.

Report: Surveys were conducted to determine current conditions of water quality and aquatic resources and habitats within the adjacent Honokōhau Harbor, the proposed Kona Kai Ola project site, and at sites potentially impacted by the proposed development. The potentially impacted habitats included the anchialine pools. Studies focused on the water quality and biological communities in anchialine pools and the overall intent of the surveys was to quantitatively describe existing water quality and benthic community conditions and to identify potential impacts associated with the proposed development.

An additional study of anchialine pools in the southern complex was conducted in response to DEIS. The survey in that study was conducted on May 20 and May 21, 2007. All pools were visually inspected each day and night at or near mean higher high tide periods. Further discussion on anchialine pools is contained in subsequent responses.

Section 3.9.1.2. Methodologies and Studies, Nearshore Environment and Coastal Waters (Appendix G: Water Quality and Marine Biological Baseline Studies and Impact Analysis) (continued)

The results presented in Appendix G suggest that groundwater is lower in salinity and higher in nutrients that oceanic waters. Because the harbor expansion will concentrate groundwater *discharge into the new marina (i.e., Figure 10), this additional discharge will increase the amount (load) of nutrients in waters discharging from the harbor entrance. Appendix G states that "Currently, brackish water discharged from harbor mouth generally flows NW, along the coastline fronting Kaloko-Honokōhau Park After construction of the new marina, brackish water flows along the Park coastline will increase" (Appendix G, page 2). This direction of water flow is not revealed in the DEIS, only in the Appendix G. The effect of higher nutrient loads in Park waters are not addressed by the DEIS. This elevated load must be thoroughly assessed to determine both direct and indirect impacts to coastal marine resources.*

Therefore, application of the Appendix G data in the DEIS for ecological baseline characterization, detection of change, or as a basis for future monitoring falls far short of adequate and is inappropriate and misleading.

Response: Appendix U addresses the analysis of the additional loads to Park waters. Since the exact amount of groundwater that will enter the new harbor is not known, the exact impact to Park waters can only be estimated. It is shown in Appendix U that, if the two layer pumping system is maintained post-expansion, the nutrient loads will remain confined to the top layers exiting the harbor. This load should have limited effect on benthic and coral communities in the park waters, and it is expected that concentrations can be maintained within Class AA standards if vigilant monitoring and BMPs are enforced post-expansion. .

The following text has been added to Section 3.9.1.3, Zone of Mixing, to reflect this information:

> At present, the salinity of the water column remains entirely saline in the bottom layers with more brackish influences near the surface (about 30 ppt). Model results displayed in detail within Appendix U show that salinity differences near the harbor entrance are completely confined to the surface layers and are at maximum about 0.5 ppt less than the current conditions of about 30 ppt (surface). Salinity at the marina entrance, at 10-foot depth is not affected by the brackish water discharge. The benthic flora and fauna close to the marina entrance and at less than 10 feet water depth face variations of salinity from 34.5 ppt to 36.0 ppt.

Section 3.9.1.3 Anticipated impacts and Recommended Mitigation, Nearshore Environment and Coastal Waters

The DEIS states: "Although the total amount of nutrients that will be generated per day will increase from the nutrient output of marine animals and users, the concentration of the nutrients will be lower due to the large amount of water available for mixing within the basin. The overall impact will be a reduction of nutrient concentration in the outflowing water." (page 44, par. 4) This statement is highly misleading. The impact must be evaluated in terms of the increase in total nutrient load discharged to the coastal ecosystem over time. In addition, the fate of this water will likely be quite different than that of the brackish groundwater discharge that occurs today. No consideration has been given in the DEIS to the flux, pathways, or impacts on the benthos, demersal, or vertebrate biota from an increased nutrient load.

Response: The impact of the increased nutrient load on the concentrations in the areas surrounding Honokōhau Harbor is addressed extensively in Chapter 6 of Appendix U. The Hawai'i State water quality standards are based on concentrations in the surrounding waters, and while the increase in loads is important, a basis for analyzing the degradation of the water quality is only found in concentrations.

While the lagoon areas do introduce new loads to the system, the primary addition of loads into the marina system comes from the interception of brackish groundwater by the new Marina. This does not introduce new loads to the coastline, but merely focuses existing loads through the harbor entrance.

Currently, loads coming from brackish groundwater inflow are 49.3 kg N/day and 6.8 kg P/day. The additions from the exhibit flow were calculated by ClowardH2O to be about 15 kg N/day. The additional brackish groundwater intercepted by the new marina is expected to be at least as much as is currently intercepted. Therefore, the loads introduced by the exhibit are about 15% of the total nitrogen introduced to the marina system post-expansion. Alternatives assessing the impacts associated with that lagoon system are presented in Chapter 5 of Appendix U. The proposed expansion attempts to mitigate additional loads as well as eliminate existing loads as much as possible.

- The current WWTP will be upgraded to tertiary treatment with the subsequent highly treated effluent spread upland of the site. This will likely reduce loadings within the groundwater surrounding the proposed site minimizing the nutrients entering Kona Kai Ola Marina through that pathway (Appendix C of Appendix U).
- The waste facilities surrounding the existing Honokōhau harbor that are currently on-site treated septic tanks that leach into the surrounding ground and likely eventually leach into Honokōhau Harbor itself will be rerouted to the newly upgraded WWTP. This is likely to decrease a significant loading to the system as was described in the data analysis shown in Chapter 1 of Appendix U.
- The possibility of eliminating the artificial lagoon system was considered and analyzed in Chapter 5 of Appendix U.
- An intensive non-point source management program is essential to maintaining water quality within the new system which is highly phosphorous limited. These sources include but are not limited to:
    - Landscaping (fertilizers)
    - Detergents from household and development use
    - Other sources

While the salinity of the exhibit inflow does cause it to act differently than the brackish groundwater inflow, it is shown in Appendix U that it is still possible to maintain the two-layer pumping system that currently exists. This two layer system causes high flushing rates, and in addition prevents advective flow through the bottom layers exiting the harbor. In this system on both ebb and flood tides, the surface water is moving out of the harbor entrance, and the bottom water is moving into the harbor. It then stands to reason that despite the high salinity of the water entering from the lagoon system, it must fully mix with the brackish water and flow out through the surface layers in order to exit the harbor.

Regarding your statement relating to “no consideration has been given in the DEIS to the flux, pathways, or impacts on the benthos, demersal, or vertebrate biota from an increased nutrient load.” The impacts to nutrient concentrations, salinity, and velocities in the bottom layers near the benthic organisms were addressed in Chapter 6 of Appendix U.

Section 3.9.1.3 Anticipated impacts and Recommended Mitigation, Nearshore Environment and Coastal Waters (continued)
Furthermore, this discharge will enter Class AA waters. HAR §11-54-03(c) (1) states, in part, “<u>It is the objective of Class AA waters that these waters remain in their natural pristine state as nearly as possible with an absolute minimum of pollution or alteration of water quality from any human-caused source or actions. [emphasis added] To the extent practicable, the wilderness character of these areas shall be protected</u>.” Although the project proposes to dilute nutrient concentrations, it will, in reality, significantly increase nutrient loads due to the

input of the proposed 75 Mgal/d of pumped seawater, input from marine animals and users, and inputs from surface water runoff to the marina and groundwater carrying nonpoint source nutrients and pollutants. Therefore, as a result of this development, water quality will be significantly altered by human caused actions in contradiction to HAR §11-54-03(c) (1).

Response: Please refer to the previous comment.

Section 3.9.1.3 Anticipated impacts and Recommended Mitigation, Nearshore Environment and Coastal Waters (continued)
The total flux of nutrients (velocity times concentration) through the harbor mouth will increase as discharge through the harbor is increased by nearly two orders of magnitude (4 Mgal/d now to the proposed 79 Mgal/d), thus exposing the National Park and surrounding waters to a greater total nutrient load. Because of its greater salinity than the fresh groundwater discharge, it will be denser and will not be confined to the upper 3-4 feet as stated in the DEIS (page 46). Furthermore, because of the huge increase in total discharge through the harbor entrance, potentially greater mixing of the nutrient-rich groundwater down to the depths of the benthic ecosystems is highly likely to occur. Elevated nutrients can lead to irreversible impacts on benthic communities such as coral death and invasive algae growth as is presently occurring in Maui County (Smith et al. 2005). This long-term adverse impact is not discussed as a possibility in the DEIS.

Response: As discussed in Appendix U, the discharge is not increased by two orders of magnitude. The 4 mgd referred to in the DEIS was an approximation of the fresh groundwater flowing into the system. In reality, this fresh water is mixed with salt water propagating through the ground to form a brackish water lens that flows into Honokōhau Harbor. Various data sources were used to calibrate this number, which was determined to be 30 mgd at 22 ppt. The calibration is detailed in Chapter 3 of Appendix U. Therefore, the increase in discharge due to the marine exhibits goes from 30 mgd to about 105 mgd. In addition, the new Marina is expected to intercept a significant amount of brackish water making the discharge through the harbor more like 130 mgd or 4 times the existing amount. The changes in velocity and nutrient concentration are analyzed in detail in Chapter 6 of Appendix U. Alternative 1 provides the opportunity to further lessen impacts and related discharge due to a 74 percent reduction of the size of the seawater lagoons, from 19 to 5 acres.

Appendix U details the numerous studies that have shown that even on ebb tide, water in the bottom layers of the harbor flows into the harbor and does not flow out. The only water that flows out of the harbor does so in the surface layers. The exhibit water contributes greatly to the degradation of the deeper waters inside the harbor, however its effect on deeper waters outside of the harbor is minimized if this two-layer pumping system is maintained post-expansion which is obtained if the brackish groundwater inflow to the new marina is high enough.

Regarding the increase in total discharge through the harbor entrance, it is found that the primary driver for containing the nutrients in the surface layer is the quantity of brackish groundwater intercepted by the new Marina. This is discussed at length in Chapter 6 of Appendix U. While the addition of saline water does impact this two layer system, if it is maintained, the nutrients are primarily contained in the surface layer.

If this system is maintained, then only water in the top layers flows out of the marina. No water flows out of the marina in the bottom layer in either flood or ebb tide. Therefore, if this system is maintained with sufficient density stratification (inflow of brackish water), there will continue to be minimal vertical mixing into the bottom layers near the reefs. Essentially, all additional saline water would have to be mixed into the top brackish layer in order to flow out of the marina, thereby containing these additional loads to the topmost layers. The effect on the surrounding waters is explained in a high degree of detail in Chapter 6 of Appendix U.

Section 3.9.1.3 Anticipated impacts and Recommended Mitigation, Nearshore Environment and Coastal Waters (continued)

We find no evidence to support the related statement, repeated several times throughout the DEIS, that large quantities of seawater pumped from the sea and discharged through the lagoons and water features will "result in extreme dilution of the groundwater entering the marina with nutrient loading that is lower than the present coastal waters. Water quality will be improved, thereby generating a positive impact on the nearshore marine environment." (Executive Summary, pg. iii, par. 4, and page 44) This statement is contradictory to prevalent scientific information and logic. Today, low salinity groundwater mostly flows buoyantly at the surface to offshore areas where it is advected by surface currents and diluted by seawater across an area extending 1-2 km offshore. In the existing harbor, this fresh-brackish water lens can extend to at least 1-3 m in thickness. Depending on the tide level, it can interact with bottom biological communities. The surface groundwater-rich layer is periodically mixed to depths of at least 15 m under high wave energy (USGS Data). With the addition of 75 mgd of highly saline (36 ppt) deep seawater, the dynamics of groundwater discharge through the harbor and into the coastal ocean will certainly change. The thin buoyant structure of present day groundwater flow will likely breakdown and, because of salinity increases due to mixing with additional deep seawater, very likely will descend deeper in the water column as it moves offshore. Thus, the nutrient loads to deeper regions of the coastal coral reef ecosystem will very likely increase, thereby degrading the water quality and not improving it as claimed. The DEIS provides no evidence to suggest this scenario will not occur.

Response: A more complete modeling analysis was performed with sensitivity testing designed to assess the impacts, both positive and negative, of the seawater lagoons on the system. This analysis in contained in Appendix U.

The numerical model that was developed in Appendix U demonstrates that the construction of the new marina, by increasing brackish water flow into the system can maintain the two layer system under high rates of brackish inflow.

> Anticipated Impacts and Mitigation Measures
>
> The water quality model was applied to predict the post-project conditions after the addition of the Kona Kai Ola Marina. Per the Conceptual Master Plan, the marina consists of a 45 acre marina basin with 800 boat slips. Brackish groundwater inflows into the new marina basin were bracketed between 0 mgd and 60 mgd. The two simulated extremes represent scenarios where no additional brackish groundwater will be intercepted by the new marina, which is not consistent with the observed conditions, and when brackish groundwater inflow into the new marina is twice the amount that will be still flowing into the existing marina, respectively.
>
> The model results demonstrated, relative to the increased area, that water quality within the proposed 45-acre marina basin system could not be maintained. Inflow of brackish groundwater to the new marina was found to be fundamental to the flushing and water quality of the proposed system. However, even for the largest simulated inflow of 60 additional mgd entering the new marina, water quality was still degraded post-expansion. This is primarily due to the fact that the proposed marina basin has five times the volume of the existing harbor. In addition, the geometry of the system led to internal circulation between the existing harbor and new marina basin. The 45-acre new marina basin only becomes viable from a water quality impact standpoint if the additional brackish groundwater inflow into the new marina exceeds 60 mgd.

Alternatives to the aforementioned system that could maintain the flushing and water quality, as observed under existing conditions, were investigated. It was found that the reduction of the volume of the new marina basin by 45 percent significantly improved the flushing and water quality. Broad range sensitivity tests were also performed to determine the effect that various parameters had on the proposed system. For example, addition of nitrogen and phosphorous loads were tested to determine the limitation of the system.

The conditions with the project constructed were found to be phosphorous limited. Several simulations were performed including and excluding the inflow from the marine exhibits which provides an additional nitrogen load and also varying the location of this inflow. It was found that the inflow from the marine exhibits can have a beneficial effect on flushing, especially when positioned within the existing harbor basin. However, its effect is significantly less than the effect due to the brackish groundwater inflow. When the exhibit inflow is excluded or positioned at the east end of the new marina, its effect is small in terms of flushing due to its high salinity. From a water quality perspective, since the loads from the exhibit inflow consist primarily of nitrogen, it does not cause increased algae growth. However, this exhibit inflow does raise the concentrations of ammonia and nitrate in the system.

Simulation results indicate that under the conditions when the post-expansion system receives an additional brackish inflow into the new 25-acre marina on the order of 30 mgd or more, water quality within the harbor system and in the surrounding waters remained similar to existing conditions. These conditions are expected to occur based on the findings reported by Waimea Water Services (2007), which states that the proposed marina would exhibit the same or similar flushing action as the existing marina.

Section 3.9.1.3 Anticipated impacts and Recommended Mitigation, Nearshore Environment and Coastal Waters (continued)
With the addition of 75 mgd of highly saline (36 ppt) deep seawater, the dynamics of groundwater discharge through the harbor and into the coastal ocean will certainly change. The thin buoyant structure of present day groundwater flow will likely breakdown and, because of salinity increases due to mixing with additional deep seawater, very likely will descend deeper in the water column as it moves offshore. Thus, the nutrient loads to deeper regions of the coastal coral reef ecosystem will very likely increase, thereby degrading the water quality and not improving it as claimed. The DEIS provides no evidence to suggest this scenario will not occur.

Response: It was found that with sufficient interception of additional brackish groundwater, the system can continue to flush under similar conditions as are found currently. The thin brackish water lens persists under conditions of brackish groundwater interception of 30 mgd or more, indicating that the mixing of the high nutrient brackish groundwater into the lower layers is not of concern if the interception of brackish groundwater is high enough. This is detailed in Chapters 5 and 6 of Appendix U.

A detailed hydrodynamic and water quality model was performed and detailed in Appendix U of the EIS. This model details results outside of the harbor, and shows that under typical conditions, the effect of the nutrient loads on the bottom layers is minimal if the interception of brackish water by the new Marina is sufficient (>30mgd). Its effects on the concentrations in the lower layers can only be seen in the shallow areas near shore (Chapter 6, Appendix U).

Section 3.9.1.3 Anticipated impacts and Recommended Mitigation, Nearshore Environment and Coastal Waters (continued)
The DEIS states: "There will be an expanded zone of mixing between the brackish effluent

and the surrounding ocean water due to the concentration of flows at the harbor mouth" (page 45). The waters immediately outside the harbor mouth are designated as Class AA, pristine waters. Hawaii water quality standards (HAR § 11-54-3 (c) (1)) further state: "No <u>zones of mixing shall be permitted in this class: (A) Within a defined reef area, in waters of a depth less than 18 meters (ten fathoms);"</u> We could find no data or evidence in the DEIS, or in Appendix H, to support a claim that the entire effluent of the 75 Mgal/d input is mixed within the harbor basin. The new marina opening is positioned such that mixing with the waters of the current harbor basin will occur almost immediately adjacent to the harbor/ocean interface. As pointed out in the DEIS and previously in these comments, high percent cover coral reef is in less than 18 m of water, adjacent to the harbor mouth.

<u>Response:</u> Currently, the system experiences a "zone of mixing" outside of the harbor that is primarily confined to the surface layers. This is deemed acceptable due to the fact that these waters rarely (except in the case of high wave energy) come into contact with the benthic communities. It was found that post-expansion this system of surface layer confinement can be maintained given enough interception of groundwater by the new Marina.

Appendix U shows through substantial testing that there are conditions that exist in which the entire 75 mgd are mixed within the harbor basin. This is categorically true if the two-layer density structure is maintained to the point in which there is no flow out of the harbor in the bottom layers even during low tide. If this holds, even highly dense waters in the lower layers of the harbor cannot leave the harbor unless they are mixed into the low density top layer.

Section 3.9.1.3 Anticipated impacts and Recommended Mitigation, Nearshore Environment and Coastal Waters (continued)

The DEIS claims that "the intake water for the [lagoon] features has low levels of nutrients (185 ug/l TDN[Total Dissolved Nitrogen] and 5.6 ug of TDP [Total Dissolved Phosphorus]" [emphasis added] (page 44). No citation is provided for these data and we could not find the source of these values for waters pumped from 100-300 feet depth in the DEIS or Appendices. The NEHLA does not have an intake pipe at the 100-300 foot depth so it appears no local, long term data are available for nutrients at this depth zone. However, NELHA surface-water data for average TDN values collected at 33', 69' and 79' depths between May 2005 and March 2006 range from 57 to 65 ug/l, increasing with depth (NELHA analytical lab data). Because nutrient concentrations are expected to increase with depth, 185 ug/l TDN is not unreasonable. However, it must be noted that it is nearly three times the concentration of TDN in the surface water. Therefore the addition of this water (75 mgd) wifi increase the total nutrient load to the harbor discharge Furthermore, Appendix G states (page 53) that " Water from this depth [100-300'] is typically low in dissolved nutrients, with concentrations often below the limits of analytical detection." Yet the 185 ug/l TDN cited for this depth is well above the limit of analytical detection for this parameter. Additionally, the marine water quality standard for Total Dissolved Nitrogen for the Kona (west) coast of Hawaii Island [HAR 11-54-06(d)] is 100 ugfl. Adequate sampling at the intake depth to confirm the range of nutrient concentrations was not conducted and the impacts of additional nutrient load are not assessed in the DEIS.

<u>Response:</u> The information related to the intake water for lagoon features was determined by ClowardH20, the consultant designing the seawater lagoons. ClowardH2O obtained the nutrient loads from the data collected by Oceanic Institute, whose report is contained in Appendix G-1, Geology and Ground-water Hydrology in the Vicinity of Honokōhau Harbor, at the deepest point along Transect D (the location of the intake pipe, (TDN=185 μg-N/L, TDP = 5.6 μg-P/L). The additional loads contributed from the animal life were also computed by the consultant designing the seawater lagoons. The analysis performed by ClowardH20 is detailed in Appendix D of Appendix U.

In addition, TDN levels at Honokōhau Harbor reported in Appendix G-1 currently are reported to be greater than 600 µg/L. In reference to these values, the value extracted for the seawater lagoons is much smaller, and since it will be discharged into the harbor system, this is the water it will mix with.

According to the sampling conducted by Ziemann (2006), all of the transects report ambient TDN levels above Class AA standards as well as TDN standards for the Kona Coast of Hawaii.

The following text was added to Section 3.9.1.3 to clarify the information:

> The water for the water features will be pumped from 100 to 300 foot depth. The total amount of water supplied to the water features will be 75 million gallons per day. The rate of pumping is designed to achieve an approximate 4 hour residence time within the ponds (pers. comm. Cloward H2O, 2007) and to prevent build up of pollutants from users and marine animals.

Section 3.9.1.3 Anticipated impacts and Recommended Mitigation, Nearshore Environment and Coastal Waters (continued)
We agree that there will be an interception and concentration of new groundwater flow to the harbor entrance (page 45, par. 1), however, the DEIS immediately, and incorrectly, contradicts this statement in the sentence following it. Most importantly, the DEIS does not adequately describe the fate and impact of this additional groundwater flow within the nearshore area.

<u>Report:</u> Appendix U deals with the impact of this additional groundwater flow extensively. The sensitivity of model results to varying degrees of brackish groundwater interception is analyzed in detail. In fact, since the groundwater flow into the existing harbor is the driving force for the current level of high water quality, its interception into the new marina is of primary importance to continue to flush the system and maintain water quality. The impact of this water on nearshore areas is also analyzed extensively in Chapter 6 of Appendix U.

Section 3.9.1.3 Anticipated impacts and Recommended Mitigation, Nearshore Environment and Coastal Waters (continued)
The DEIS states: "The large amount of water will dilute any pollutants that enter the harbor basin from groundwater or surface water. This will improve the water quality and be a positive impact on the nearshore environment. " (page 45, par. 1) The preceding statement claiming that water quality will improve does not fully consider the large-scale increase in nonpoint source loads of toxins and pollutants from fertilizers, pesticides, volatile organic compounds, petroleum products, trash, heavy metals, treated wastewater for irrigation, etc., that will be carried in surface water originating from the massive land-based scale of this development. The development, which includes commercial and industrial parks, large hotel and condominium buildings, parking lots, roadways, waterways and injection wells, will concentrate polluted runoff to groundwater and the marina. The document inappropriately exhibits its bias and lack of required objectivity (HAR §11- 200-14) on page 40, stating that the project site will "probably cause an increase in runoff volume" [emphasis added]. The DEIS states that the lagoon will have a plastic lining to protect the water features from stormwater runoff (page 100). However, the lower elevation of the water feature will cause it to act as a drainage receptacle for surface runoff and will concentrate the pollutants discharged into the marina basin. (See additional discussion in Section 4.10.10) The 45-acre marina itself will be a significant source of many of these pollutants (some listed on page 46), however impacts of microbiological contaminants potentially introduced to the lagoons and

waterways and holding pools from animals and humans are not considered, nor are the potential impacts of microbiological contaminants on human health or the affected ecosystems. Monitoring is not discussed in the DEIS. It is not stated if or how the water feature discharge points would be closely monitored for water quality. Nor is it clear if the water feature discharge points would require an NPDES permit. These nonpoint source and point source pollution issues are either ignored or given cursory mention in the DEIS, and no details for monitoring, or enforceable solutions are analyzed or offered by this "green" developer. Pages 46 and 47 do indicate some Best Management Practices for decreasing some of these problems, however it should be noted that the present harbor has difficulty enforcing these BMPs. Discussion of prevention, management, and enforcement throughout the lifespan of the development is missing from the document.

Response: Mitigation of runoff impacts will be further specified in design plans and will be determined during the permitting process when final designs are developed. JDI will stipulate low impact development techniques as part of the general design guidelines. The Best Management Practices (BMPs) will be very site specific and must be incorporated with the building and landscape design. BMPs will be incorporated to minimize runoff volume and peak flow, minimize the quantity of pollutants in runoff or flows to groundwater, and maximize re-use of storm water for natural irrigation.

Section 3.9.1.3 Anticipated impacts and Recommended Mitigation, Nearshore Environment and Coastal Waters (continued)
The DEIS states: "The average outflow from the harbor will increase from 4 mgd to 79 mgd. The salinity of the water will change from an average of 33.5 ppt to about 34.4ppt. The water will still be less dense, and the depth of impact will be limited to the surface 3 to 4 feet. The benthic flora and fauna will face a smaller variation in salinity that will discourage opportunistic biota dominance and lead to a healthier and more diverse benthic community. This is a positive impact on the benthic environment." (page 46, par. 1) As already stated above, these conclusions are scientifically unsupported in the DEIS.

Response: A 3D hydrodynamic and water quality model was calibrated for existing conditions within Honokōhau Harbor and was extended to include the proposed expansion and various alternatives. It is described on page 3-35 of the EIS, and is documented in full in Appendix U.

In actuality, 4 mgd refers to the approximate quantity of fresh groundwater flowing into the system. The hydrodynamic model inflows were calibrated to be 30 mgd at 22 ppt. Therefore, the 75 mgd of saline water increases the outflow from the harbor to 105 mgd. This does not account for additional brackish groundwater intercepted by the new Marina as well as the increase in tidal prism. All of these effects are taken into account within the 3D hydrodynamic and water quality model presented in Appendix U.

As the model results show in Appendix U, the salinity changes at the harbor entrance are confined to the surface layers (provided adequate brackish groundwater interception: >30 mgd), and the areas below 10-ft of depth experience no change in salinity. This indicates that organisms that are currently in favorable environments will remain so.

Section 3.9.1.3 Anticipated impacts and Recommended Mitigation, Nearshore Environment and Coastal Waters (continued)
Furthermore, Hawaii water quality standards, state the following for basic water quality criteria applicable to all waters [including Class A harbors]: "<u>All waters shall be free of substances attributable to domestic, industrial, or other controllable sources of pollutants, including ... (5) Substances or conditions or combinations thereof in concentrations which produce undesirable aquatic life;"</u> [HAR § 11-54-4 (a)] It is possible that the significant

changes resulting from the various aspects of the water features may create conditions that are beneficial to pathogens or alien invasive species. The DEIS does not address these possibilities, or suggest mitigation for them. Increases in vessel traffic are expected with the proposed marina expansion. Vessels with larger ranges are known transport sources and mechanisms contributing to the further spread of marine alien and invasive species in Hawaii. The potential for introduction of alien marine species was pointed out to Oceanit in the NPS response to the EIS preparation notice (Appendix A). The DEIS does not respond to comments regarding the serious issue of alien species as required by HAR 11-200-15 (D), though the response letter from Oceanit said the issue would be addressed. The State of Hawaii has an aquatic invasive species management plan (DAR 2003), which is not considered or referenced in the DEIS).

Response: The changes brought upon by the inclusion of the water features were analyzed extensively in Appendix U. It was found that the saline water features have an effect on the flushing of the harbor, but not one that is nearly as significant as the influence of the brackish groundwater. It was found that the nutrients introduced by the water features are primarily nitrogen and do not have a significant effect on phosphorous limited algae growth. It was also found that the inclusion of the saline water features does necessarily preclude the existence of a two-layer density stratified system similar to the one that exists currently.

The changes and post-expansion conditions in the areas containing significant coral populations are discussed at length in Chapter 6 of Appendix U. The mechanisms of uptake, concentrations, nutrient flux, and various other conditions are discussed in these environments.

Section 3.9.1.3 Anticipated impacts and Recommended Mitigation, Nearshore Environment and Coastal Waters (continued)
The DEIS states: "The increase in the outflow will cause a very slight increase in water velocities" age 46, par. 1). The DEIS does not estimate or comment on the increase in surface current velocities and related potential navigation hazards within the harbor mouth owing to a 3-fold increase in tidal prism and additional outflow associated with 52,000 gal/mm (75 Mgal/d) for the proposed water features. A simple calculation shows that the average rate of 52,000 gal/min discharge into the proposed water features and harbor would increase the depth averaged current velocities at the harbor mouth by 1.0 to 1.3 cm/sec. A 3-fold increase in tidal prism (volume added to new expanded area) would also notably increase these velocities but is not mentioned in the DEIS. These increased current velocities may be compounded by surface flows during ebb tides and during water level set-up and set-down within the harbor associated with long-period swell. Increased current velocities may be significant for human-powered activities (e.g., canoes) and smaller power craft when exiting or entering the harbor.

Response: An analysis of depth averaged and depth variable currents leaving the Harbor can be found in Chapter 6 of Appendix U. However, it was found that depth-averaged currents could increase up to about 4 cm/s through the harbor mouth. This is due to the increase in tidal prism, the addition of the water features water, and the additional brackish groundwater intercepted by the new Marina which were all taken into account within the numerical modeling effort. Surface current estimations are also presented Appendix U and could potentially rise by up to about 4 cm/s on ebb tide.

Section 3.9.1.3 Anticipated impacts and Recommended Mitigation, Nearshore Environment and Coastal Waters (continued)
Furthermore, the increased tidal prism will likely increase mixing, bringing more of the nutrient-rich groundwater down closer to the seafloor, potentially negatively impacting the benthic ecosystems. Additionally, it will likely increase the zone of mixing laterally, potentially

delivering higher nutrient loads to a greater area of the National Park and surrounding waters.

<u>Response:</u> The mixing effects of the increased tidal prism were tested within the 3D hydrodynamic and water quality model. It was found that if the intercepted quantity of brackish groundwater was sufficient (>30 mgd), the two-layer density stratified system persisted despite the increased tidal prism. The nutrient-rich groundwater remained confined within the surface layers.

The lateral zone of mixing will likely increase due to the concentration of brackish groundwater through the harbor entrance, the addition of water features flow, and the increased tidal prism, however if the two-layer stratified system is maintained, this zone will continue to be confined to the surface layers.

Section 3.9.1.3 Anticipated impacts and Recommended Mitigation, Nearshore Environment and Coastal Waters (continued)
Changes to current velocities and directions in nearshore waters, and potential significant impacts from the additional 75 Mgal/d exiting the harbor at a "rate of pumping designed to achieve rapid turnover of water" (page 44), are not discussed in the DEIS. Secondary impacts to fish and coral recruitment, and other related physical and biological processes due to changes in current velocities and direction are also not considered. Existing research on these topics in the National Park and surrounding waters was not considered in the DEIS. Potential impacts to local benthic habitat at the pipeline installation sites are also not discussed.

<u>Response:</u> Changes to the current velocities and directions in nearshore waters are discussed at length in Chapter 6 of Appendix U. Changes are not significant outside of the harbor entrance. At the harbor entrance, current velocities can increase by up to 4 cm/s.

Section 3.9.1.3 Anticipated impacts and Recommended Mitigation, Nearshore Environment and Coastal Waters (continued)
<u>Water Clarity</u>
The DEIS does not address the impact of the proposed harbor expansion and associated development on water quality and clarity of the existing harbor or nearshore waters. At present, water clarity is maintained by an "upwelling" circulation system maintained by offshore flow of buoyant groundwater that reaches at least 1-3 mm thickness. This circulation system and the present water clarity are likely to be compromised by changing the circulation dynamics due to tidal flow changes within the proposed expanded harbor. The DEIS does not address this topic to evaluate the impact on circulation and water clarity within the existing harbor. Nor is there any discussion on the potential short and long term impacts to water clarity (turbidity) outside the harbor resulting from the addition of 75 Mgal/d to harbor outflow. HAR § 11-54-04(a), Basic water quality criteria applicable to all waters, states "All <u>waters shall be free of substances attributable to domestic, industrial, or other controllable sources of pollutants, including: ... (3) substances... in amounts sufficient to produce objectionable color, turbidity, or other conditions in the receiving waters."</u> The DEIS does not consider these potential long-term adverse impacts to coastal water quality.

Response: A three dimensional water quality model was calibrated and run to determine the impacts of development on the water quality of the harbor and the nearshore area. The complete study report is attached as Appendix U. The report shows modeled results for current profiles at peak flood, salinity distribution at flood tide, and chlorophyll a concentration distribution, for the existing harbor and future development scenarios. Also the effect of harbor expansion on flushing time, nutrient concentrations, Chlorophyll a concentrations in the harbor, proposed marina, the nearshore area immediately outside the harbor entrance, and in the surrounding nearshore waters are described in the report.

The model study revealed that construction of the 45-acre, 800-slip marina as described in the Conceptual Master Plan increases the flushing time of the harbor significantly. It also modifies the two layer flow system that currently maintains good water quality in the harbor. AS an alternative a smaller (25-acre) 400-slip marina was tested in the model. The model results showed that reducing the marina size is an important factor in maintaining water quality independent of the groundwater flow increase.

Overall results of the study showed that for the 400-slip marina with brackish water inflow in the order of 30 million gallons per day or greater, the water quality conditions at both marinas, the harbor entrance and Honokōhau Bay will be very similar to the existing conditions, provided that ammonia-nitrogen load from the exhibit water is reduced. All attempts will be made to reduce the ammonia–nitrogen concentration in the exhibit effluent before reaching the harbor. The seawater lagoons in Alternative 1 will be reduced by 74 percent from the lagoons in the proposed project, and that the density of marine animals in the lagoons in Alternative 1 will also be decreased from that proposed in the proposed project.

Water clarity depends on productivity resulting in plankton. Productivity depends on the nutrient concentrations and the resident time. Since with the reduction in the size of the marina does not increase nutrient concentrations or resident time in the area, the water clarity is expected to remain the same.

Section 3.9.1.3 Anticipated impacts and Recommended Mitigation, Nearshore Environment and Coastal Waters (continued)
In addition to direct ecosystem impacts from reduced water clarity (e.g., Rogers 1990, Richmond 1993, impacts to water clarity can negatively affect the local economy. Fifteen (15) day-use mooring buoys are located within the immediate vicinity of the existing harbor mouth and are heavily used by local scuba diving and snorkel charter businesses. The dive/snorkel industry is a significant component of the state economy, particularly in West Hawaii. Throughout the state, Hawaii's nearshore reefs annually generate about $800 million in gross revenue (Davidson et al. 2003). However the costs of degradation are significant. For example, more than $20 million per year is lost in Kihei, Maui alone due to impacts of algal blooms (Davidson et al. 2003). Currently, the state of West Hawaii's reefs is good (e.g., Waddell 2005), However, a current University of Hawaii study contracted by the County of Hawaii (Wiegner et al. 2006) analyzed available long- term water quality data for coastal developments in West Hawaii and suggests that "conditions in West Hawaii maybe developing for extreme environmental degradation, possibly resulting in algal blooms like those in West Maui" (Wiegner et al. 2006, page 5). Ecosystem and economic impacts to water clarity resulting from the proposed project are not examined in the DEIS.

Response: The water quality modeling shows that the impacts on water quality are minimal. Therefore, the secondary impacts also will be minimal.

Appendix H. Zone of Mixing Report
In May, 2006, the National Park Service and the US Geological Survey were contacted by coastal engineers at Moffett and Nichol, who had been contracted by Jacoby Development, to model circulation and water column properties in the harbor and the adjacent coastal waters. Moffett and Nichol's engineers requested in situ instrument data from the USGS to provide boundary condition and calibration information for the three-dimensional numerical model. This advanced mixing models was not incorporated in this DEIS and its exclusion brings into question the reliability of the modeling results and impact assessment.

There is insufficient data on nearshore oceanographic processes. The oceanographic measurements reported in the Appendix H mixing study were made during May when precipitation and submarine groundwater (and thus brackish harbor water) discharge are low. Therefore, the meteorologic and oceanographic forcing, and the resulting flow and water column properties measured at the harbor mouth during the sampling period are different from times of high submarine groundwater discharge (page 2). Thus, the temporally-limited data collection efforts reported in Appendix H in May 2006, do not accurately or adequately characterize flow and groundwater (and thus brackish harbor water) discharge throughout the year. Furthermore, the results presented in Appendix H do not represent extreme outflow conditions as stated (page 1).

Response: The 3D numerical model implemented by M&N is detailed in Appendix U. In situ data obtained from the USGS was used for calibration of this model.

Appendix H. Zone of Mixing Report (continued)
The May 10-12, 2006 measurements were not collected at spring high tide, as stated in the report (page 2), but rather the transition between the spring and neap tides. Thus the results presented in the DEIS do not, as stated, represent extreme outflow conditions (page 1).

Without information on the location of the ADCP (page 2), the harbor cross-section (page 4), and the CTD sampling stations (page 5), it is impossible to put the results in the necessary contexts of the appropriate geologic (bathymetric steering) and oceanographic (shear, eddies, etc) setting. This lack of information makes it difficult to determine if the conclusions drawn from these measurements are valid.

Response: We agree that the fresh groundwater flow rates may vary from wet to dry season. The average fresh groundwater flow is estimated to be 2 to 3 mgd per shoreline mile. The larger circulation is driven by tides as shown by Oki et al. The estimated brackish water flow through the harbor is estimated from water quality measurements to be about 25 to 30 mgd. The field measurements were conducted to obtain real data to check on the vertical salinity distribution occurring at site. This data was used with other existing information to calibrate the three dimensional model operated to predict impacts on water quality. There is no data available on the temporal variation of groundwater flow in the area. The intent of the study was to estimate the zone of mixing under specific conditions and get calibration information. The study was not intended to determine mixing dynamics for the area over a year.

The water quality and mixing model report is attached as Appendix U. This report discusses in detail the water quality conditions that would occur under different groundwater and lagoon water flow conditions.

Appendix H. Zone of Mixing Report (continued)
No information on the depth that the drifters' were drogued to is presented (page 2). Because the surface layer's thickness is spatially and temporally variable, it is unclear on what water mass the drifters were tracking and thus how the data supports the results presented. Drifter direction and velocity could simply reflect wind forcing alone, and potentially not be indicative of water movements.

No ADCP velocity data is shown, only directional information. Because the flux of a property is a function of the concentration of the property times the water velocity (magnitude and direction), the results stated on page 3 cannot be validated.

Response: The measurements were made not exactly on a spring tide because the ebb tides on this cycle occurred either during early morning or late in the afternoon. However, tide measurements were made at the site to track the water level during the survey.

The ADCP was used to estimate the net outflow from the harbor. The instrument was mounted at the bottom close to the harbor entrance midway between the mouth and the last bend. The cross section shown is where the ADCP was located. No conclusions were drawn on mixing within the existing harbor. Mixing data measured was used as supplemental information for the calibration of the 3-D mixing model.

The drogues were designed to follow the surface water layer. The drogues were designed to follow currents at 5 foot depth and had small projected areas above water to avoid wind effects. Salinity profiles were measured at the drogue locations, when the drogue location was determined. No permanent stations were used for salinity profiling.

Appendix H. Zone of Mixing Report (continued)
The report states that eddies are likely shed by the walls of the harbor channel (page 4), and the directional data presented in the DEIS show incredibly high directional spread, yet all of the calculations are based on one ADCP velocity profile and one CTD profile (page 7). The data presented in the DEIS suggest that the event used for the calculations is temporally limited and thus does not characterize the nature of water flow and the flux of brackish water out of the harbor entrance. As such, the data are inadequate to verify statements in the EIS.

Response: ADCP velocity data was sampled at 15 minute intervals. And average data were used in the volume calculations. Directional information of velocity at different cells was used to determine the velocity structure. Because directional data had significant noise probably due to the local channel geometry, data for ebb tide was used developing the current profile. The data for ebb were averaged to remove the effects of noise. The data used are therefore not temporally limited and indicated average conditions during an ebb tide.

Appendix H. Zone of Mixing Report (continued)
Because the proposed harbor expansion will increase the tidal prism by more than three times, the current velocities measured at the harbor entrance and the resulting flux of brackish water out of the proposed harbor will be much greater than that out of the existing harbor. This increase is not addressed at all in this report. Furthermore, the greater volumes of water moving in and out of the proposed expanded harbor and greater current velocities will result in two important impacts also not addressed in Appendix H or the DEIS. First, this increase will cause greater vertical mixing; bringing more of the high-nutrient brackish water (see discussion of Section 3.9.1.3 above) closer to the seafloor, which increases the possibility of negative impacts to benthic communities. Second, the larger outflow prism may cause the zone of mixing to be expanded spatially, potentially delivering higher nutrient loads to a greater area of the National Park and surrounding waters. (See comments on Section 4.8.2 for resulting navigation safety impacts.)

Response: The Harbor expansion will increase the tidal prism. Tidal prism approach is not adequate to determine the velocity and density structure in the expanded harbor. A three dimension water quality model was used to determine the current distributions, salinity distributions, nutrient distributions and Chlorophyll a distributions resulting from the development. The model was calibrated using the existing groundwater flow data, water quality data in the existing harbor and data collected fro the zone of mixing study. The modeling study details and results are given in the report attached as Appendix U. The results show that with a 400-slip marina expansion the water exchange structure in the harbor will be maintained as a two layer flow, very similar to the existing condition. The nutrients and water velocity impacts are confined to the upper layer above the benthic strata, and impacts on benthic communities are not anticipated. The distribution of various water quality parameters in Honokōhau Bay in the vicinity of the harbor entrance are shown in Appendix U.

Appendix I. Wave Penetration Study
The input bathymetry is not of sufficient resolution for high-level models, as it is based on the older NOAA data rather than new, available LIDAR bathymetry data collected in 2000. (US Army Corps of Engineers; http://shoals. sam.usace.ariny.millhawaii/pages/hawaii_Bigjsland.htm). The coarse resolution of the bathymetry used missed a number of known bathymetric features that could significantly modify the wave modeling results.

Response: The suggestion of using the LIDAR data for the bathymetry in the wave model is appropriate. However, the NOAA data used is not significantly different than the LIDAR data as illustrated in the attached (Attachment 5) figure showing LIDAR contour data as color shaded contours along with the wave model bathymetry contours illustrated by contour lines. Note there is not LIDAR data in the entrance channel and the harbor.

The shape of the contours, which is the important characteristic for any wave focusing simulated in the wave model, is very similar, particularly in the entrance to the harbor where the bathymetry is most critical. The shoreline area to the north in shallow water is slightly off, but this area is not critical for the wave modeling as the waves arriving in the harbor entrance channel do not cross over this area. The water depths immediately offshore of the harbor entrance out to a depth of 7 m are almost identical in the two data sets. For depths greater than 7 m, the wave model bathymetry is shallower than the LIDAR depths by about 1 m. If the water depths in the model were increased by this amount, the wave penetration into the harbor may increase slightly, but as discussed below with regards to a comparison between model predictions and prototype wave monitoring results, the wave model predictions are already slightly higher than prototype measurements. It should also be pointed out the model predictions are still useful for relative comparison between existing and proposed configurations. Attachment 5 depicts a Comparison Between Lidar Bathymetry and BW Model Bathymetry.

Appendix I. Wave Penetration Study (continued)
There were no in situ data collected, or at least reported, to verify the model results; thus there is no way to evaluate the accuracy of the modeling results (pages 3-6), which is necessary for impact analysis.

Response: - At the time of the wave modeling work, a field monitoring program to measure prototype waves both inside the harbor and outside of the harbor entrance was still being developed. Prototype data have now been collected and comparisons of the measured and predicted wave transformation coefficient are available. Wave data were collected from 8/24/06 through 9/26/06 every 4 hours at a location outside the harbor in a water depth of approximately 18 m and at a location inside the inner harbor. The wave height ratio, or wave transformation coefficient, between the two gages averaged over the entire monitoring period was 5%. Model predictions for a similar wave environment indicated a wave height ratio of 23% which is substantially higher than the measurements, although the wave climate within the new harbor is still acceptable for moored vessel motion and the predicted impact of reducing wave heights in the existing marina due to the proposed modification are minimal. The prototype monitoring results will be incorporated into the final revision of the wave modeling report.

Section 3.9.3.1 Anchialine Ponds, Existing Conditions
HAR §11-200-12 (B) 9. states "...an action shall be determined to have a significant effect on the environment if it: ... 9. Substantially affects a rare, [emphasis added] threatened, or endangered species or its habitat." The DEIS confirms that anchialine pools and their rare endemic flora and fauna will be substantially affected by their total destruction.

The DEIS states (page 48) "Ponds in the southern complex are moderately to heavily impacted, with many containing fish that exclude the anchialine crustaceans." This statement is inaccurate and misleading. An accurate portrayal of the southern complex pools is that some are moderately to heavily impacted, but others are in near pristine condition with no bottom sediment and water residence times likely short enough to mitigate the presence of high nutrient concentrations. A few pools concurrently contain both the endemic shrimp species (including the rare Metabetaus loehena, a candidate endangered species) and alien fish (NPS observation, USGS unpublished data), though only one such pool is listed in Appendix G Table 7. The NPS also questions Table 7 in the reported numbers of the common endemic shrimp (opae'ula) Halocardinia rubra found in the pools.

In 2002 the US Geological Survey—Biological Resource Division surveyed approximately 25 pools south of Honokōhau Harbor within the legislated boundary of the National Park (note: pool numbers herein are "approximate" because of the interconnectedness of some pools at high tides). The survey was specifically designed to detect M. loehena (whereas the DEIS survey was not). Approximately 15 pools contained M. lohena, with 6 pools having average pool densities exceeding 100 M. lohena individuals. Almost all of the pools also contained alien guppies and/or mosquito fish. H. rubra were not quantitatively sampled in the survey. M. lohena was found to be particularly numerous at the eastern end of the complex (USGS unpublished data).

At the conclusion of this section the DEIS states: "These factors [elevated nutrients concentrations] indicate that f no restoration or maintenance activities are instituted to reserve these ponds, these ecosystems will degrade beyond recovery." This sentence appears to make the oft heard argument in development documents that the resource is in such bad shape, or will be eventually, that there will be no significant loss or impact from destroying it. The same argument is repeated on page 51, par. 1, ending with the assertion that "Even without the potential impacts from the proposed marina construction, the pond ecology might change irreversibly from the nutrient input, human indifference and expansion of non-native fauna species." This statement and others like it in the document are deliberately misleading to the readers unfamiliar with the site and pools in its portrayal of the condition of the pools. The loss of these pools and their rare endemic inhabitants (two of which are candidate endangered species) is indeed significant and irreversible. Anchialine pools are an important cultural and natural resource that is being lost island-wide to development. The pools on this site in particular have national significance and were specifically described in the nomination form designating the Honokōhau Settlement National Historic Landmark. (See NPS letter Appendix A). Preservation of these unique and nationally significant resources is of paramount importance. The DEIS did not include an alternative that protects these features from harm.

Response: The DEIS presented information stating that harbor construction would cause an increase in salinity in the anchialine pools makai of the proposed marina basin to become equivalent to the ocean at 35 parts per thousand (ppt) and that the anchialine biology would then perish.

In response to DEIS comments and to further study the pools south of the entrance channel of Honokōhau Harbor, a second study was conducted by David Chai of Aquatic Research Management and Design in June 2007. The second survey focused on intensive diurnal and nocturnal biological surveys and limited water quality analysis of the southern group of anchialine pools exclusively. The report is contained in Appendix H-2 of the EIS and is summarized in EIS Sections 3.9.2.1 and 3.9.2.2. In addition, further comment on the groundwater hydrology effects on anchialine pools was prepared by Waimea Water Services and is contained in Appendix G-3 of the EIS. Attachment 6 contains the EIS Sections

3.9.2.1 and 3.9.2.2, and Attachment 7 contains the study prepared by Aquatic Research Management.

Mitigation measures to facilitate the long term health of the remaining anchialine pools will be based on environmental monitoring, which is vital as an early warning system to detect potential environmental degradation. A series of quantitative baseline analysis of the physio-chemical and biological components within the project site will provide a standard by which the effects of the development, anthropogenic activities, and natural phenomena on these environments can be measured.

The framework for the mitigation plan will include three measures intended to meet these objectives, including bioretention, salinity adjustment and possible new pools.

Bioretention, which is a Best Management Practice (BMP) is a feasible application for the proposed development. There is a probability that nutrients and other potential pollutants will runoff landscaping and impermeable surfaces such as roadways and parking lots during medium or high rainfall events. Some of these pollutants could enter the groundwater table and into anchialine pools and ultimately the ocean. As an alternative to directing runoff into the ground through drywells, storm water may be directed into bioretention areas such as constructed surface or subsurface wetlands, vegetated filter strips, grass swales, and planted buffer areas. Storm water held and moved through these living filter systems are essentially stripped of most potential pollutants, and allowed to slowly infiltrate back to the groundwater table.

Another mitigation measure that would be included in the management plan is salinity adjustment. In the 2006 assessment regarding the impact to the southern pools from the proposed construction of the harbor, it was stated that this construction would cause the salinity in the anchialine pools to become equivalent to the ocean at 35ppt. It was then concluded that the anchialine biology would perish.

There is currently a level of uncertainty by professional hydrologists as to the exact movement of surface groundwater and final determination of anchialine salinity following the harbor construction. The assessment that all anchialine pools will be barren with the construction of the harbor may be premature. *Halocaridina rubra* (‘ōpae‘ula) are routinely drawn from high salinity wells at 30-32 ppt. If the pools do become full strength seawater at 35ppt, there exists uncertainty on the long-term effects to anchialine organisms, since there are no long-term studies or examples of native anchialine ecosystems at 35 ppt. Native anchialine pool vegetation also has relatively high salinity tolerance.

If the salinity were expected to rise to 35 ppt, possible mitigation in the management plan will include methods to surcharge man-made anchialine pools created adjacent to or in the vicinity of natural pools with low salinity well water. If sufficient volume is used, it is theoretically possible to lower salinity in adjacent natural anchialine pools. This surcharge method has been successfully used to raise salinity in anchialine pools in West Hawai‘i and cause the salinity rise in adjacent pools of at least up to 10 meters away. Surcharging with low salinity should work as well or better since the lower density water will essentially float atop the higher salinity water at the surface layer, and move throughout the complex of natural pools. Surcharging may also be a viable mitigation to dilute and more rapidly disperse any pollutants that may be detected in the pools.

Another mitigation measure includes the creation of new anchialine pools. There is significant opportunity to create new anchialine pools and greatly expand the native habitat and resource. It has been demonstrated at several projects in West Hawai‘i that anchialine pools can be created and will be colonized with a full complement of anchialine species endemic to the area. Anchialine pools are considered focal points of higher productivity relative to the subterranean groundwater habitat around them. Their productivity promotes an increase in population levels of anchialine species within the pools themselves and throughout the subterranean habitat surrounding them.

Section 3.9.3,2 Anchialine Pond, Anticipated Impacts and Recommended Mitigations (continued)
The DEIS claims that anchialine pools to the north (in the National Park) are "not likely to be impacted." This statement demonstrates vagueness resulting from incomplete groundwater studies (see discussion on Section 3.8.1), a lack of knowledge of the source of the project's required 2.6 Mgal/d of freshwater and associated impacts, and a lack of sensitivity to the protection of a cultural and natural resource that is vital to the mission of the NPS. Potential impacts to the pools in the National Park on the northern side of the harbor must be assessed through appropriate, more detailed groundwater studies and additional information on the source of water for the project.

Response: These lands are outside the project area and not under the jurisdiction of the State. Kona Kai Ola does not include any construction or other activity on these lands. No additional study of these lands is planned in conjunction with the proposed project. From the hydrology studies the pools north of the harbor won't be affected by the new marina construction.

Section 3.9.3.2 Anchialine Pond, Anticipated Impacts and Recommended Mitigations (continued)
The conclusion (page 51) that the candidate endangered orangeblack Hawaiian damselfly, Megalagrion xanthomelas, is not present on site due to "the impacts from high nutrient input and general degradation of the ponds" is unsupported. M. xanthomelas was not observed during the three survey days most likely because the survey method used was inappropriately designed to detect this candidate endangered species in terms of methodology and effort (including seasonal timing, diurnal timing, and effort-hours). Appendix G contains no survey methodology for surveying for the damselfly. The USGS surveys in 2002 established the presence of this candidate species (USGS unpublished data). The current study is insufficient to claim the species is no longer on site and the reasons for its "absence." These findings indicate that the project must include consultation with the U.S. Fish and Wildlife Service and the DLNR Division of Aquatic Resources to ensure candidate endangered species are protected.

Response: The following text has been added to Section 3.9.2, Anchialine Pools, and responds to your comment:

> The average salinity in Kealakehe pools is relatively high at 13.5 ppt compared to most other pools along the West Hawai'i coastline, having an average of approximately 7 ppt. This high salinity appears to be characteristic of this region, and is similar to the average of most pools within the adjacent ahupua'a of Honokōhau and Kaloko. The levels of nitrate-nitrogen levels are relatively high compared to other undeveloped areas, but fall in the range of some developed landscapes. Other water quality parameters, including pH and temperature, fall into normal ranges for anchialine pools.
>
> This relatively high salinity is the likely reason aquatic insects were not found in any pools at Kealakehe. Though the rare damselfly *Megalagrion xanthomelas* has been observed and collected from Kaloko, a statewide assessment of its range has not found it to occur in water with salinity greater than 3ppt. However, there has been an unsubstantiated occurrence of the nymph in a pool of up to 8ppt (Polhemus, 1995).

Section 3.9.3,2 Anchialine Pond, Anticipated Impacts and Recommended Mitigations (continued)
DEIS suggests establishing a buffer zone for the newly created marine ponds as mitigation for the destruction of anchialine pools (page 51). However, marine ponds and anchialine pools are not the same cultural or natural resource, therefore the buffer is not mitigation for the anchialine pools that are destroyed. In terms of anchialine pool protection, no purpose is served by buffering an artificially created marine pond. Further, the DEIS proposes "to move as much of the existing population of <u>Metabetaeus lohena</u> from these anchialine ponds before they become too saline, to possible newly excavated ponds that may be developed off-site." It is unclear where these newly excavated ponds are to be located. The environmental impact of the creation of new pools is not addressed nor is consultation with the USFWS. Finally, the suggestion that "Public education on the unique ecology of the anchialine ponds and the need for preserving their ecology will reduce future human impacts in other healthy ponds" (page 51) appears out-of-place in a project that will result in significant impact to the ecology of rare anchialine pools and their endemic flora and fauna.

<u>Response:</u> As discussed previously, additional mitigation has been proposed in the second anchialine pool survey.

Section 3.9.4 Marine Fishing Impacts
The proposed marina expansion will increase fishing pressure on the blue marlin as well as other fish stocks. Although the DEIS does not adequately examine other important Kona fisheries such as ahi and ono, the data provided in Section 3.9.4.1 and in Appendix Q indicate that the local blue marlin population is decreasing. Furthermore, there is evidence that Kona is a breeding ground for blue marlin (Appendix Q, page 6), and therefore increased fishing pressure will have a significant long term adverse impact on these local fish stocks and, as a result, the fishery. However Section 3.9.4.2 downplays the negative impact to the local marlin population and fishery by stating that "It is not likely that the fishing pressure from the expanded charter fleet will have an adverse impact on the Pacific-wide fishery" [emphasis added] (page 52). The proposed promotion of "Slot Limits" (page 53) is a good idea and can be enforced in tournaments. However, the operators of the proposed marina will have no authority to issue or enforce these regulations for the charter fishery outside of tournaments. While there is merit in recommending educational programs "promoting" conservation management, education alone will not solve or mitigate the issue of over fishing.

<u>Response:</u> The following text has been added to Section 3.9.3, Marine Fishing Impacts, to respond to your comments:

> Impacts on Marlin and Tuna / Pelagic Fishery
>
> The impact on the marlin and tuna fisheries from increased harbor capacity will be a function of the number of new boats in the harbor targeting these fisheries and the ability of these new boats to attract paying customers. Both marlin and large tuna fisheries have been shown to be in general decline according to private, state, and national fisheries statistics. There are several hypothesized causes for these declines relating primarily to international fisheries. The ability of the State to manage these pelagic marine fish stocks is limited by the national and international fishing policies.
>
> Proposed Mitigation
>
> An increase in the harbor size offers the opportunity to consolidate, focus, and fund management and enforcement activities at one centralized location. The pressure on fish and invertebrate stocks, as well as upon populations of marine mammals and turtles can be expected to increase as the Kona population increases, regardless of whether the

harbor is improved. The following changes could be made by DLNR, paid for at least in part by the additional revenues to DLNR from the Kona Kai Ola project. These changes are in the management authority of the DLNR Division of Aquatic Resources and the DLNR Division of Boating and Ocean Recreation.

- Increase in the number of fisheries enforcement and management personnel in Kona at one centralized harbor location
- Allocation of slip and office space for fisheries personnel and equipment
- Increased numbers of submerged mooring buoys (presently approaching 100) at all dive sites,
- Increased education materials for recreational divers and fishermen
- Initiate restrictions on the quantity and size of boats in each commercial sector
- For inshore species, initiate catch restrictions in line with Division of Aquatic Resources guidelines that prioritize recreational fishing above commercial fishing, and subsistence fishing above recreational fishing.

Section 3.9.5.1 Marine Mammals and Sea Turtles, Existing Conditions
Humpback Whales
Humpback whales are commonly sighted in park waters and immediately offshore of the National Park water boundary. This occurrence is not mentioned in the DEIS.

Response: In response to DEIS comments, Marine Acoustics, Inc., (MAI) was retained to conduct three studies, as follows:

- Description of Marine Mammal and Sea Turtles (Appendix S)
- Ambient Noise Measurements and Estimation Study (Appendix T-2)
- Acoustic Analysis of Potential Impacts (Appendix T-3)

These studies have been presented by MAI to the officials from Kaloko-Honokōhau National Historic Park and the U.S. National Marine Fisheries Service. Preliminary mitigation measures have been proposed and further refinement is being developed through consultation with both agencies. The revised Section 3.9.4, Marine Mammals and Sea Turtles, are included in this letter as Attachment 8.

The following text responds to this comment and has been added to Section 3.9.4.1, Affected Environment. Additional information is contained in the three studies that were provided to you earlier.

Humpback Whales: The population of humpback whales (*Megaptera novaeangliae*) around Hawai'i was estimated to be between 4,500-6,500 in 2000 (Mobley et al 2001). The population growth rate between 1993 and 2000 is estimated to be seven percent indicating that the population is recovering from its dramatic reduction due to commercial whaling. It is worth noting that this is considered a high rate of increase for a mammalian species.

The highest densities of animals are found within the 100 fathom isobath. Most humpbacks off Hawai'i are found north of Honokōhau in the waters of the Hawaiian Islands Humpback Whale National Marine Sanctuary. Nevertheless, they are commonly seen off Honokōhau in winter months. Humpbacks are not deep diving animals. Whales in Hawai'i typically dive to less than 100 feet, although occasional deeper dives are possible (Hamilton et al. 1997)The whales breed and give birth while in Hawai'i during the winter months, and migrate north to feed each spring.

Section 3.9.5.1 Marine Mammals and Sea Turtles, Existing Conditions

Dolphins

The DEIS provides no study or literature review on the Hawaiian spinner dolphin (Stenella longirostris), or other small cetaceans similarly exposed to vessel traffic, tourism, construction, and degraded water quality, to assess potential impacts from these concerns on this protected species. The DEIS does not state that spinner dolphins are protected under the Marine Mammal Protection Act (16 Usc 1361 et seq.) and that "take" (i.e. harass, hunt, capture or kill or attempt to do so) [16 USC 1362(13)] is unlawful. "The term "harassment" means any act of pursuit, torment. or annoyance which— (i) has the potential to injure a marine mammal or marine mammal stock in the wild: or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing. breeding, feeding. or sheltering." [16 USC 1362(18)]. consultation with NOAA regarding potential impacts to marine mammals is not mentioned in the DEIS.

The DEIS claims the dolphins "at times intentionally congregate near the harbor channel to take advantage by bow-riding outgoing vessels" [emphasis added] (page 54, par. 3). This statement is grossly misleading. Although dolphins do bow-ride on vessels in the channel, the authors of the DEIS are also aware (NPS and others have provided the information) of data and studies describing the harbor channel as a known and primary spinner dolphin "resting area," i.e., an area close to shore routinely used during the day to rest, care for young, and avoid predators before traveling to deeper waters to forage throughout the night (Norris et al. 1994, Ostman-Lind et a!. 2004). These areas are considered important to the health of the spinner dolphin population (e.g., Norris and Dohl 1980, Norris Ct al. 1994, Ostman-Lind et al. 2004). The DEIS states (page 54) that spinner dolphins rest in Honokōhau Bay (which is a large area), but does not reveal the location of the resting area and misleadingly implies that the sole biological reason for the dolphins congregating at this site (the outer harbor channel) is to bow-ride. Spinner dolphin resting areas, in protected bays and coves in the main Hawaiian Islands, are well documented (Norris and Dohl 19.80, Norris et al. 1994, Ostman-Lind et al. 2004). Spinner dolphins generally have a core area in each resting location where they spend most of their time while in rest (Dr. Jan Ostman-Lind, Kailua Kona, pers. comm.; unpublished data). In Honokōhau Bay, which is one of only six primary resting areas on the Kona coast (Ostman-Lind et al. 2004), the resting area is located between the harbor mouth and the green buoy, and includes the boat channel and areas south of the channel (Ostman-Lind, pers. comm.; unpublished data).

Potential impacts to Hawaiian spinner dolphins from the proposed action are not discussed in Section 3.9.5.2 Anticipated Impacts and Recommended Mitigation. However on (page 54, par. 5) the DEIS states: "Given the sporting habit of spinners and other dolphins of bow-riding ships and small boat wakes, they are apparently not overtly impacted by vessel traffic noises." The assertion in this statement is also grossly misleading and unsupported by the recent scientific literature (e.g., Bejder et al. 2006a, 2006b). A significant increase in boat traffic and dolphin-watching tourism is also very likely to have a significant negative impact on this species as has been documented for bottlenose dolphins in Australia and New Zealand (e.g., Constantine et al 2003, Hastie et al 2003, Bejder et al. 2006a, 2006b, Lusseau 2003a, 2005). These studies document effects from small boats on marine mammals. The initiation of a jet-ski rental business would also have a significant negative impact on this species.

The volume of boat traffic passing directly through the preferred resting area is also likely to be an important factor in impacting resting spinner dolphins. If the volume of vessel traffic were to triple or quadruple, it is likely that the higher noise level could interfere with communication in addition to interrupting rest. ft is a possibility, unexamined in the DEIS, that the dolphins cannot tolerate additional traffic volume at this site. It is possible that the present amount of traffic may already be near the upper tolerance limit for the dolphins because increases in vessel traffic likely decreases the time of rest for these animals (e.g., Constantine et al. 2003), which in turn may have adverse *energy budget and life history consequences (e.g., Lusseau 2003b). No study has been performed or presented in the DEIS to assess the current condition, and understand and evaluate the future impacts of traffic, tourism, and construction on dolphins in this primary resting area.*

Response: The following text responds to this comment and as been added to Section 3.9.3, Marine Fishing Impacts. Additional information is contained in the three studies that were provided to you earlier.

> **Dolphins:** A number of dolphin species are found in the waters near Honokōhau Harbor. Detailed information on all of these can be found in Appendix S. Spinner dolphins (*Stenella longirostris*) are regularly seen in shallow water and in close proximity to the project site. They are the smallest dolphins typically seen in Hawaiʻi, with a mature size of 6 feet in length and 160 pounds.
>
> Spinners school in pods of a few animals to 180 or more, with pod sizes of 1-20 being most common (Östman-Lind et al. 2004). They feed on mesopelagic fish, squid and shrimp in deep water at night, and rest in nearshore shallow waters during the day (Norris and Dohl 1980; Benoit-Bird et al. 2001). There are seven primary resting areas along the Kona coast of Hawaiʻi, including Honokōhau Bay, where spinners are regularly seen near the harbor entrance (Östman-Lind et al. 2004). There is some evidence that the spinner dolphins may be resident to the area (Östman-Lind et al. 2004), making them more susceptible to repeated disturbance.
>
> The hearing ability of spinner dolphins has not been measured. However, hearing of the related striped dolphin (*Stenella coeruleoalba*) was measured between 500 Hz and 160 kHz, with maximum sensitivity at 64 kHz (Kastelein et al. 2003). The hearing response of this single dolphin was less sensitive below 32 kHz than other dolphins.
>
> Despite their limited sensitivity to low frequency sound, spinner dolphins have been shown to be impacted by human activity. Examples include interruption of resting activity and increases in the number of higher energy behaviors (Luna-Valiente and Bazúa-Durán 2006). Numerous studies describe changes in distribution (Haviland-Howell et al. in press) and short-term behavioral changes of dolphins in response to vessel traffic (Bejder et al. 1999; Scarpaci et al. 2000; Gregory and Rowden 2001; Nowacek et al. 2001; Van Parijs and Corkeron 2001; Ritter 2002; Lusseau 2003; Ng and Leung 2003). However, it has been established that for at least one population of bottlenose dolphins, these repeated short-term effects translate into long-term detrimental effects on the affected population (Bejder et al. 2006a; Bejder et al. 2006b).
>
> In Hawaiʻi, some entanglements of spinner dolphins have been observed (Nitta and Henderson 1993; Rickards et al. 2001) but no estimate of annual human-caused mortality and serious injury is available. A habitat issue of increasing concern is the potential effect of swim-with-dolphin programs and other tourism activities focused on spinner dolphins around the main Hawaiian Islands (Östman-Lind et al. 2004).

Section 3.9.5.1 Marine Mammals and Sea Turtles, Existing Conditions
Hawaiian Monk Seal
The DEIS erroneously dismisses the Hawaiian monk seal as an animal that is not likely to be impacted by the project activities. No data on the occurrence of Hawaiian monk seals in the area are presented in the DEIS. Monk seals do haul-out in the National Park, and it can be inferred that they are swimming in Honokōhau Bay where they would be exposed to construction noise and increased boat traffic. Between 2003 and 2006 a total of 13 monk seal sightings (counted by calendar-day, i.e. an individual seal is counted only once per day even if it was sighted several times in the day) were reported in the National Park (NOAA Protected Species Division data). It is important to recognize that these reported sightings by the general public and NPS staff are not systematic, that is, there is no dedicated regular survey effort in the National Park to locate monk seals and that these sighting do not represent the overall use by seals of the Honokōhau Bay shoreline. Appendix Q, Underwater Noise Impacts (page 7), proposes a visual look-out to detect seals out to a quarter mile during construction, which will be less than effective. The statement that "monk seals are air breathing and spend the majority of their time above water where they are easily observed" (page 54) is incorrect and misleading. When seals are at sea, they are difficult to detect because they spend most of their time submerged. Detection of seals at the surface is also very difficult because of their low profile.

Response: The following text responds to this comment and as been added to Section 3.9.3, Marine Fishing Impacts. Additional information is contained in the three studies that were provided to you earlier.

> **Hawaiian Monk Seals:** Endangered Hawaiian Monk Seals (*Monachus schauinslandi*, Hawaiian Name: ʻIlio holo I ka uaua) are rare, but not unknown along the Kona Coast. Most monk seals are found in the Northwest Hawaiian Islands, but recent aerial surveys estimated that there are 52 seals in the main Hawaiian Islands (Baker and Johanos 2004). There have been 13 sightings between 2003 and 2006 in the vicinity of Kaloko-Honokōhau National Historical Park (NOAA protected species division data) indicating regular, albeit low-level use of these areas by monk seals. Two birth on the Island of Hawaiʻi have been reported (Baker and Johanos 2004).
>
> The best population estimates for Hawaiian monk seals (as of 2003) was 1,244 (Carretta et al. 2004). However the population is currently showing a decline that has been continuing since the 1950s (Antonelis et al. 2006).
>
> Underwater hearing in the Hawaiian monk seal has been measured between 300 Hz to 40 kHz. Their most sensitive hearing is at 12 to 28 kHz, which is a narrower range compared to other phocids. Above 30 kHz, their hearing sensitivity drops markedly (Thomas et al. 1990).
>
> Monk seals are very intolerant of human activity and are easily disturbed. When the U.S. military inhabited Sand Island and the Midway Islands and Kure Atoll, the monk seals disappeared until after the military left. Monk seals prefer to be solitary animals (Reeves et al., 2002).

Section 3.9.5.1 Marine Mammals and Sea Turtles, Existing Conditions
Turtles
Green sea turtles (Chelonia mydas) and hawksbill sea turtles (Eretmochelys imbricata) are present in National Park and surrounding waters, adjacent to the project site. Hawksbill turtles are critically endangered in Hawaii, however a few identifiable individuals are known to frequent certain turtle "cleaning stations" and dive sites in either side of the harbor channel. (NPS data, L. Choquette pers. comm., K. Laros pers. Comm.). The DEIS does not discuss the presence of the hawksbill sea turtle at the site or potential impacts to this species.

West Hawaii subpopulations of green turtles are currently free of the so called "Green Turtle Fibropapillomatosis Disease" (Murakawa et al. 2000). Since 1999 the NPS has worked *cooperatively with the NOAA Fisheries Marine Turtle Research program (MTRP) to monitor the health of the juvenile green sea turtle population in the National Park. Data on health, demographics, abundance, behavior, movements on the coral reef, sources of anthropogenic impacts, strandings, and degree of "residency" have been collected. One hundred eighty six individuals have been tagged with microchips, and the recapture rate of these turtles is greater than 70%. The National Park is an important feeding and resting habitat for resident juvenile green turtles on the West Coast of Hawaii (NOAA MTRP data, NPS data). The subpopulation of green turtles in the National Park consists of juveniles with strong site fidelity and can be considered "resident" (MTRP data, NPS data). Therefore, local adverse impacts occurring as a result of the proposed project, e.g., exposure to several years of construction noise, to increased amount of vessels and vessel noise, to greater levels of pollutants, trash, and degraded water quality, to increased fishing interactions/entanglements, potential increases in boat strikes, and significantly greater exposure to harassment from a concentration of tourists at the shoreline will likely affect most of the turtles repeatedly. These impacts will be significant, negative, and long term. Only a few of these impacts are assessed in the DEIS,*

*The DEIS erroneously cites only three turtle strandings within a radius of 10 miles of Honokōhau Harbor since 1982 (page 55, par. 3). The three erroneous "strandings" cited in the DEIS are actually the **subset** of strandings that are unquestionably attributable to boat strikes (George Balazs pets. comm.), The authors inaccurately reinterpreted the number of reported boat strikes within 10 miles provided by Balazs to the total number of reported stranding. Since 2000, the NPS has responded to turtle strandings inside the National Park for NOAA Fisheries. Between 2000 and 2006, 20 strandings were recorded from the harbor (1 turtle) and inside National Park boundaries (19 turtles). One turtle with a severe propeller strike injury in the National Park survived and was not included in the three strikes provided by Balazs (two outside of the Park, one inside). Additionally, boat strike was implicated, but not definitive, in another of the 20 strandings (NOAA necropsy data). Six of the 20 strandings were a result of entanglement in fishing gear and 11 additional turtles have been freed of entanglements during the same time period (NOAA MTRP and NPS data). It is important to note here that the recorded number of strandings and entanglements does not reflect the true number occurrences within the National Park, the harbor, or within 10 miles of the harbor, nor do the number of boat strikes to turtles for the following reasons: 1) there is no daily systematic survey along the West Hawaii coast for stranded turtles; encounters are opportunistic, and 2) boat strikes are potentially more likely to go unrecorded due to the nature of the injury combined with the anatomy of turtles (lungs are positioned immediately under the carapace, i.e., the turtle's back. Therefore fatalities from boat strikes are likely to sink). Boat strikes and entanglements are significant adverse impacts to marine turtles and the risk will increase proportionately to the size of the marina as a result of increased number fishers and of vessels transiting the areas where turtles are regularly found. The statements and conclusions in Section 3.9.5.2 (page 56) regarding "no documentation of adverse impacts" to turtles inside the harbor and the "very low" potential for impacts to turtles from boat strikes and fishing is based on inaccurate information and are therefore unfounded.*

Response: The following text responds to this comment and as been added to Section 3.9.3, Marine Fishing Impacts. Additional information is contained in the three studies that were provided to you earlier.

> **Sea Turtles:** Five species of sea turtles are known to frequent Hawaiian waters, with Hawaiian green sea turtles (*Chelonia mydas*) by far the most abundant at 97% of the total numbers, hawksbill turtles (*Eretmochelys imbricata*, 1.7% of total), olive ridley turtles (*Lepidochelys olivacea*, 0.8%), and occasional sightings of leatherback (*Dermochelys coriacea*) and loggerhead sea turtles (*Caretta caretta*, Chaloupka, et al, 2006, from stranding reports). Green sea turtles are the most plentiful large marine herbivore in the world and have experienced a very successful population recovery in Hawaiian waters since 1974 when harvest was outlawed in Hawaiʻi, and 1978 when they became protected under the Endangered Species Act (Balazs, et al. 2004). Both green sea turtles and hawksbills are known to breed and nest on beaches within the main Hawaiian

Islands, and have a 25-30 year generation time with a life span of 60-70 years (Balazs et al 2004). Total population numbers of green sea turtles in the Hawaiian archipelago have not been estimated, but the population has at least tripled since the 1970s and may now be approaching the carrying capacity of the islands (Chaloupka, et al. 2006).

Bartol et al. (1999) measured the hearing of juvenile loggerhead sea turtles using auditory evoked potentials to low-frequency tone bursts found the range of hearing to be from at least 250 to 750 Hz. The frequency range that was presented to the turtles was from 250 Hz to 1000 Hz (Bartol et al. 1999).

Most recently, Bartol and Ketten (2006) used auditory evoked potentials to determine the hearing capabilities of subadult green sea turtles and juvenile Kemp's ridleys. Subadult Hawaiian green sea turtles detected frequencies between 100 and 500 Hz, with their most sensitive hearing between 200 and 400 Hz. However, two juvenile green turtles tested in Maryland had a slightly expanded range of hearing when compared to the subadult greens tested in Hawai'i. These juveniles responded to sounds ranging from 100 to 800 Hz, with their most sensitive hearing range from 600 to 700 Hz. The two juvenile Kemp's ridleys had a more restricted range (100 to 500 Hz) with their most sensitive hearing falling between 100 and 200 Hz (Bartol and Ketten 2006).

Adult green turtles are primarily herbivorous often seen on reefs as deep as 100+ feet but much more common in shallower waters. Foraging behavior of green turtles is well documented and in Hawai'i is typically characterized by numerous short dives (4 to 8 min) in shallow water (typically less than 3 m) with short surface intervals (less than 5 sec) (Rice et al. 1999).Resting periods are characterized by longer dives (over 20 min) in deeper water (4 to 40 m) with surface intervals averaging 2.8 min (Rice et al. 1999). The amount of time that turtles spend foraging versus resting is still largely unknown. Green turtles in Hawai'i frequently use small caves and crevices in the sides of reefs as resting areas, and spend significant amounts of time on the tops of reefs (Balazs et al. 1987). Green turtles are known to be resident in Kiholo Bay, Hawai'i (Balazs et al. 2000), and presumably other areas as well, potentially increasing their susceptibility to vessel collision and/or repeated disturbance. Two turtle "cleaning stations" have been reported near the mouth of Honokōhau Harbor. Vessel collisions and potential noise impacts are a concern with regard to turtles. In a study of 3,861 turtle strandings in the main Hawaiian Islands from 1982 – 2003 (Chaloupka, et al. 2006), boat strikes accounted for only about 2.7 percent of the cases and were almost always fatal (95 percent). Entanglement in gill nets accounted for about six percent of strandings and also had a high rate of mortality (75 percednt). Hook and line entanglement (seven percent of strandings) was much less likely to result in the death of the turtle (52 percent mortality). At least 20 green sea turtles have stranded in Honokōhau Harbor or along the boundaries of Kaloko- Honokōhau National Historical Park.

Recent increases in longline fisheries may be a serious source of mortality. Greens comprised 14% of the annual observed take of all species of turtles by the Hawai'i-based longline fishery between 1990 to 1994 (NMFS 1998a). Over the period of 1994 to 1999, it was estimated that an annual average of 40 green sea turtles were caught by the Hawai'i-based longline fishery (McCracken 2000).

Recent proliferation of a tumorous disease known as fibropapillomatosis (Herbst 1994) may reverse improvements in the status of the Hawaiian stock (NMFS 1998a), although recent modeling suggests that population levels continue to increase despite the disease (Chaloupka and Balazs 2005). The disease is characterized by grayish tumors of various sizes, particularly in the axial regions of the flippers and around the eyes. This debilitating condition can be fatal and neither a cause nor a cure has been identified.

Hawksbill turtles (Eretmochelys imbricate) are observed less often than green sea turtles near Honokōhau. About 20-30 female hawksbills nest annually in the Main Hawaiian

Islands (NMFS 1998b). In 20 years of netting and hand-capturing turtles at numerous nearshore sites in Hawai‘i, only eight hawksbills (all immatures) have been encountered at capture sites including Kiholo Bay and Ka‘u (Hawai‘i), Palo‘ou (Moloka‘i) and Makaha (O‘ahu) (NMFS 1998b). It was only recently discovered that hawksbills appear to be specialist sponge carnivores (Meylan 1988). Previously they had been classified as opportunistic feeders on a wide variety of marine invertebrates and algae.

Increasing human populations and the concurrent destruction of habitat are also a major concern for the Pacific hawksbill populations (NMFS 1998b). Hawksbill turtles appear to be rarely caught in pelagic fisheries (McCracken, 2000). However, incidental catches of hawksbill turtles in Hawai‘i do occur, primarily in nearshore gillnets (NMFS 1998b). The primary threats to hawksbills in Hawai‘i are increased human presence, beach erosion and nest predation (*e.g.,* by mongooses) (NMFS 1998b).

Section 3.9.5.2 Marine Mammals and Sea Turtles, Anticipated Impacts and Recommended Mitigation; & Appendix Q, Underwater Noise Impacts Review

The impact of low frequency noise on marine fauna is falsely understated. Ample evidence exists in the literature that small boat noise does have an impact on the marine environment (e.g., Smith et al. 2004a, 2004b, 2006; Scholik and Yan 2002a, 2002b, 2002c; Samuel et al. 2005, Suzuki et al. 1980, Popper 2004) and such studies were not discussed in the text of the DEIS. Some of these papers are referenced in Appendix Q, but with little or no meaningful discussion.

The DEIS states that sea turtles “abandoned their offshore (30-100 ft depth) resting habitats and concentrated in very near shore waters adjacent to the harbor [under construction] and, at times, even within the active construction areas as soon as blasting and excavation began” (page 56, par. 1). An examination of the source of this statement in Appendix Q Underwater Noise (page 2) reveals that the statement does not cite a scientific study or the consultant’s reports for the harbors under construction, but instead cites “personal communication” from consultants working on the construction projects. Because no supporting documentation or existing data were cited, it cannot be verified from the DEIS if the stated actions of the turtles were (1) determined by studies with statistically appropriate methodologies specifically designed to detect responses of marine turtles during construction, or (2) a few turtles (number unknown) were casually observed. It can be assumed if a scientifically appropriate study or data existed, it would have been cited. Therefore the statement above in the DEIS is potentially misleading and must be considered unsupported by scientific data, as are the broad conclusions that harbor construction does not negatively impact sea turtles.

The proposed mitigation for increased boat strikes, extending the no-wake zone, is appropriate, however as noted elsewhere for mitigation proposed by this DEIS, there is no discussion of how enforcement will be accomplished in the long term. Without enforcement capability, there is effectively no mitigation.

The DEIS offers no estimated values of sound frequencies and sound pressure levels anticipated as a result of blasting and pile driving construction activities. No estimate of the number of days these sounds can be expected in the air an underwater environment is made, (though it can be assumed that the 45-acre basin could take more than a year). Furthermore, no details are provided for review on a visual or an acoustic monitoring program, that will “adjust construction activities” (page 57, par. 1) when marine animals are present. The DEIS offers no information on the on the methodology for animal detection, i.e., criteria for minimum animal-distance to alter construction activity, and what construction activities would be altered. This proposed mitigation does not take into account that spinner dolphins are primarily silent during resting (Norris et al. 1994), that sea turtles do not produce sounds, and that monk seals do not vocalize underwater. Appendix Q proposes a visual look-out (not mentioned in the DEIS) but does not state how animals that spend the majority of their time submerged (hawksbill turtles, green turtles, monk seals) would be detected. The DEIS lacks details for this monitoring and mitigation activity, and does not propose monitoring that would be effective at detecting marine mammals and turtles. Alternatives for mitigation to reduce construction sounds are not considered in the DEIS.

HAR §11-200-19 requires that information in an EIS be presented in an easily understood manner and that data presented should be commensurate with the importance of the impact. Undue cross- referencing should not be needed. Section 3.9.5.2 and the review in Appendix Q in particular are incompletely researched and presented. Samuel et al. (2005) is in the reference list in Appendix Q Marine Fisheries Study, but not in the Appendix Q Underwater Noise Impacts list (where it belongs), and is never cited in text in either Appendix (both confusingly titled "Q"). The Samuel et al. study examines an important potential adverse impact, effects of boat noise on marine turtles. The findings of the study are not discussed and the topic itself is barely touched on in the DEIS text or the Underwater Noise Appendix. Nine papers are listed in Appendix Q but not discussed or referenced anywhere in the text. Appendix Q also incorrectly asserts (page 6) that "Green sea turtles are on the EPA [sic] protected species list due to their resemblance to Hawksbill turtles which are on the endangered species list." [emphasis added]

<u>Response:</u> Acoustics and ambient noise impacts on marine mammals and sea turtles have been completely re-analyzed. Your comments provided a benchmark for conducting these studies, and have been fully addressed. As stated earlier, Attachment 8 contains the full EIS section that discusses marine mammals and sea turtles, and further detail is contained in the three reports that were previously submitted to you.

Section 3.9.6 Ciguatera

Kaloko-Honokōhau National Historical Park is a high cultural-use area for subsistence fishing. An outbreak of ciguatera as a result of the proposed project would affect traditional subsistence fishing, and pose a significant human health hazard. The Kona coast already leads the state in ciguatera poisoning (Gollop 1992, Ley 2002, Parsons in press). The ciguatera-causing dinoflagellate, Gambierdiscus toxicus, has been known to increase in concentrations after human or natural disturbances, including harbor construction (Randall 1958, Anderson & Lobel 1987). Thus, the project could cause a local outbreak of ciguatera in the National Park.

<u>Response:</u> Ciguatera is discussed in Section 3.9.5 and has been acknowledged as a potential problem coastal development in general. In response to your concern, we have modified our discussion of impacts and mitigation to clarify that, because the ecological mechanism leading to a population bloom of the causative dinoflagellate is unknown, there can be no preventive action and that monitoring is the best mitigation to protect public health. This type of monitoring has become standard in association with coastal projects and has been shown to adequately track population levels of the causative dinoflagellate and therefore predict outbreaks of ciguatera. Section 3.9.5 has been revised as follows:

> **Anticipated Impacts and Mitigation Measures**
>
> <u>The potential for a bloom of the ciguatera causing dinoflagellate associated with coastal construction is an ongoing concern in tropical waters. Although there does appear to be a correlation between coastal construction activities and blooms of the causative dinoflagellate, the correlation is far from conclusionary and the ecological mechanisms leading to bloom conditions are not clear. Because the mechanism is not understood it can not be controlled. Therefore the only mitigation possible is to conduct monitoring and make appropriate public health announcements should a bloom occur. Monitoring for the causative dinoflagellate should be conducted for a minimum of two years: 1 year prior to construction (to create a known baseline) and 1 year after population levels have fallen to pre-construction levels.</u>

3.9.7 SWAC Facility

The DEIS provides almost no information about the SWAC system or about the disposal of the effluent water (7,500 gpm), which "will be either directed to deep wells or to facilities where secondary use of this resource will occur." (page 59) However, elsewhere in the document (Appendix G page 3) it is stated this effluent will be piped to an offshore outflow *that is at approximately 250 m deep. A proposed system of this magnitude, which has potentially significant impacts resulting from seawater withdrawal, the fate of the effluent, and the location, construction and operation of the pumping facilities (see comments Sections 4.4 and 4.10.10) must be detailed for public review in the DEIS. The potential impacts from each alternative: mariculture and its effluent disposal, injection back to the ocean, or injection to groundwater must be presented. For example, effects of injection to groundwater will depend on many factors, including the quality of the effluent, the final density of the effluent relative to the density of the groundwater near the injection depth, the rate of injection relative to the rate of ambient groundwater flow, the hydraulic properties of the rocks, and the extent of mixing. In terms of water levels, the injection could cause an increase in pressure in the groundwater system, possibly leading to a slight increase in water levels. The potential impact on water quality to the National Park's fishponds and anchialine pools is not examined.*

Response: We disagree with your statement that "almost no information" is presented on the proposed SWAC facility. In addition to the DEIS summary discussion, a full report is contained in Appendix K, Cooling Water Intake Analysis (formerly Appendix J). Information is related to the overall system process, water intake process, system infrastructure, possible impacts and mitigation measures. As stated in the EIS, this information is based on the current concept plan. More details will be provided in applications for permits, including a Conservation District Use Permit.

Section 4 Assessment of Existing Human Environment
Section 4.1 Cultural Resources
The DEIS does not identify the Ala Kahakai National Historic Trail in the cultural resource section. The mission of the National Historic Trail is to preserve in place ancient and historic trails and routes. Page 63 of the DEIS mentions cartographic evidence of a shoreline trail route coming from Lanihau. Because this trail connected features contained in the cultural landscape, it should have been incorporated into the planning for a shoreline trail system. The preservation and management of pedestrian use of ancient and historic trails and routes were not incorporated into the development landscaping and pedestrian circulation plan. The loss of integrity of mauka-makai trails and lateral shoreline trails by not preserving them in place is a significant negative impact.

The preferred management alternative in the Draft Ala Kahakai NUT Comprehensive Management Plan/EIS, referred to as the "Ahupua'a Trail System," calls for the preservation of a system of trails that includes ancient and historic shoreline and near shoreline routes in order to incorporate features such as what is now referred to as the "Mamalahoa Trail" and mauka-makai trails. Destruction of trails is not consistent with the intentions stated and overtures presented in public by JDI to preserve the Hawaiian culture.

Respond: Please see response to your comments on cultural resources in this letter.

Section 4.1.2.1 Cultural Resources, Anticipated Impacts and Recommended Mitigation
The DEIS states that "In interviews, one of the greatest areas of cultural concern was potential impacts to water quality as related to fishing grounds and ponds." (page 64) and that "It is recommended that the cultural and archeological resources be protected... ." The water quality of the anchialine pools will be destroyed. These anchialine pools are currently important sources of opae 'ula gathered for traditional subsistence fishing, and historically important as water sources and other uses. Most have been modified by people and are also archeological features. The DEIS provides no evidence to support that water quality in the equally culturally important marine environment will be maintained with the current plan (see comments on section 3.9.1). No studies are provided or cited that show groundwater withdrawals will not affect water resources in the National Park (see comments on section

3.8.1). In the National Park, the water itself is a cultural resource; the dynamic thread that ties the cultural and natural environment together. Present day activities and cultural practices in the National Park, and in the proposed project area, rely on the quality of the water resources for those practices. The pools, the fishponds, the ocean waters continue to provide life to the people. To degrade them is a significant adverse long-term impact.

Response: Please see our response to your comment regarding anchialine pools on pages 55 to 58.

Section 4.1.2.1 Cultural Resources, Anticipated Impacts and Recommended Mitigation
The two heiau within the proposed project area are ceremonial structures, therefore the views of the mountain and the entire viewshed are of utmost importance to traditional practices. In the cultural impact statement, Mr. Mahealani Pai talks about the cultural importance of the view of the mountain from the ocean. (Appendix K, page 25). It is not clear in the DEIS how makai to mauka viewsheds will be preserved by the proposed construction (eg., 4-story hotels on 20-50 feet graded land, page 28) since no graphic visual impact analysis exists.

Response: A visual impact analysis was prepared in response to DEIS comments and is included in Attachment 3 of this letter. Please see responses to your comments on visual impact in this letter

Section 4.2 Archaeological Resources
Section 4.2.1.2 DLNR and Parkway Corridor Site Findings
The DEIS does not mention the Ala Kahakai National Historic Trail or the National Historic Landmark designation that applies to a portion of the project site in this section.

Response: Please see our response on page 10 of this letter. Pertinent EIS revised text is included in that acknowledges and supports the Ala Kahakai National Historic Trail.

Section 4.2 Archaeological Resources
Section 4.2.1.2 DLNR and Parkway Corridor Site Findings (continued)
It also appears that no human-modified anchialine pools were included in the 432 listed archeological features. Most if not all of those pools were modified by humans and have been utilized for perhaps hundreds of years, as such they too are archaeological features and should have been included in the list of archaeological sites that will be destroyed by the proposed undertaking. No direct connection in the DEIS appears to be made between the cultural and natural aspects of the anchialine pools.

Response: The basis for determining which sites would be further studied and preserved is the criteria outlined in the Rules Governing Procedures for Historic Preservation Review (DLNR 1998: Chapter 275). The criteria provide a management tool that addresses levels of significance and future action. Only human modifications to anchialine pools are given feature designations. The Archaeology Impact Study documents seven architectural features at Sites 1898 and 1899 that modify natural pools. However, the pools are not assigned feature designations. While it is likely that all were used, if there is no physical evidence of use, then a site/feature designation was not assigned.

Hence, while archaeological features have cultural value, not all archaeological sites meet Criterion e. The archaeological study identified eleven sites as culturally significant based on the presence of burials or ritual architecture.

Section 4.2 Archaeological Resources
Section 4.2.1.2 DLNR and Parkway Corridor Site Findings (continued)
Page 68 of the DEIS states: "The most significant (in length) trail segment is 7704 which is

428 feet long marked by 26 aligned cairns. This trail segment is located on the makai boundary of the wastewater treatment plant and extends in a north south direction but appears to be a partially constructed spur of another trail that was abandoned and not utilized." Trail 7704 along with the trail identified in the Emerson 1880 Map (Site 50-10-27-2 1588) should be preserved and would compliment the "Ahupuaa Trail System" as it pertains to the mission of the Ala Kahakai. MIT (see Section 4.1 above).

Response: The Archaeology Impact Study does not recommend preservation of 7704 trail because, as stated on page 227 of Appendix M-1, "The Site 7704 is an historic 19th Century trail. The absence of abrasions on the lava associated with this very straight trail led Soehren to conclude that it represented a 'preliminary route selection' for a nineteenth century horse trail that was subsequently abandoned, perhaps in favor of the 'Old Mamalahoa Trail, farther inland (Sorhren1980:2)." In other words, the 7704 "trail' is comparable to a series of lathe stakes marking one or more alternate routes for a proposed road. One could also argue that the site's integrity was been significantly diminished by its truncation by the massive spoil pile from harbor construction.

Section 4.2 Archaeological Resources
Section 4.2.1.2 DLNR and Parkway Corridor Site Findings (continued)
According to the DEIS, no trails outside of the shoreline setback or buffer are to be preserved. More effort should have been placed on 1) locating and preserving Trail 21588 (see comments below on Appendix L), 2) preserving trail 7704, and 3) consultation with Ala Kahakai NHT on preservation and mitigation, especially since the project area derives its name from a trail or path. As explained in the DEIS (page. 62, par.I): "The translation of Kealakehe is interpreted in two ways: 1) Kealakehe, with the emphasis on the last syllable, translates as "the pathway of graves ", 2) Kealake 'e, with an 'okina replacing the "h, " is the more popular definition, which means "winding path."

Response: Trail 21588 was identified by thorough background research and could not be relocated. The 1880s Emerson map, which is depicted in Figure 5 of the Archaeological Impact Study, shows a road or trail extending from the south toward Kailua to the coast at Honokōhau. The trail appears to pass through the portion of project area situated north of the harbor access road, but no evidence of it was identified during the survey. The area in was surveyed three times during the fieldwork with archaeological surveyors walking at 3-5 m intervals. The same area was surveyed during preliminary studies for the project in 2004, also with negative results. Surveyors, including archaeology consultant Alan Haun, were specifically looking for worn surfaces, petroglyphs, and cairns. At the time the vegetation was not that thick. Areas of bare pāhoehoe lava were clearly visible and all were checked. It is possible that there is no evidence of the trail because this area consists of nearly level pahoehoe lava.

Trail 7704 was discussed in the previous response.

Initial consultation with the State Historic Preservation Division (SHPD) has occurred. Further consultation will occur with the Ala Kahakai NHT, SHPD, and ethnic organizations or members of ethnic groups, including native Hawaiians, for whom some of the sites may have significance in order to seek their views.

Section 4.2.2 Anticipated Impacts and Recommended Mitigations
Significant archeological sites and features within the project area are major features that honor the landscape, its history, and descendants. The DEIS states (page 69) that 29 of 182 (page 67) archaeological sites are recommended for preservation in accordance with a Site Preparation Plan and that 13 of these sites are within the Kaloko-Honokōhau NHP legislated boundary (Appendix L states 25 will be preserved; page 229), However, Figure Q shows

there are 19-22 sites within the legislative boundary recommended for preservation, and the number of sites to be preserved shown in Figure Q is 34. Fifty four known archeological sites are proposed for destruction, plus 47 are recommended for mitigation through data recovery, totaling 101 sites destroyed (however our count is 153; 182 sites minus 29 sites). These discrepancies are confusing and possibly misleading as to the actual number of sites to be destroyed. All sites within the NHL and the National Park boundary must be preserved. The mitigation proposed in the DEIS, data collection, is inadequate. The DEIS contains no other mitigation proposals.

Response: Appendix L contained two archaeological studies. The study conducted in 2006 on DLNR property identified 25 sites for preservation. The study conducted in 2001 on DHHL property identified 4 sites for preservation for a total of 29 sites identified for preservation. Please see page 10 of this letter for information on how the EIS has been revised based on your comments.

Figure T has been revised to depict 29 sites, and contained in Attachment 9.

The proposed mitigation is consistent with in the Rules Governing Procedures for Historic Preservation Review (DLNR 1998: Chapter 275).

Appendix L: Archeological Inventory Surveys 2006
Ala Kahakai National Historic Trail is not mentioned. The archaeological report does not fully acknowledge the presence of the National Historical Landmark (NHL), nor does it mention "Honokōhau Settlement," (State site 50-10-27-4138). The National Park's legislative boundary is identical to the NHL boundary and should have been depicted on all such maps. When discussing preservation criteria it is important to know previous designations. The inclusion of sites within the NHL boundary is definitely a matter that should be discussed within the findings and individual site descriptions. All sites within a National Historical Landmark are considered contributing elements to the significance of the NHL as a whole.

Response: Please see our response on page 10 of this letter regarding EIS revised text that acknowledges and supports the Ala Kahakai National Historic Trail.

The Archaeology Impact Study acknowledges that 13 sites recommended for preservation are within the legislative boundary of the Kaloko-Honokōhau National Landmark on pages ii and 229, and on Table 15. Further, Pages 1-6 and 1-7 of the EIS acknowledge the presence of the National Historical Landmark and the Honokōhau Settlement National Landmark.

Appendix L: Archeological Inventory Surveys 2006 (continued)
Within the northeastern DLNR parcel that abuts Kaloko-Honokōhau NHP and the DHHL parcel, a trail identified within the report and referred to as the trail on Emerson's 1880 map (page 12, par. 4, figure 5 and page 227, par. 5) was not located during the survey. This trail is well documented within the National Park as site 50-10-27-21588. A portion of the trail was destroyed in the development of Gentry's Marina boat yard. In 2002, an archeological survey was conducted by the National Park for a temporary sewer line through the State Highway easement between Queen Ka'ahumanu Highway and the DHHL parcel. During the NPS survey, the trail was located along with a well-defined causeway. The trail within the National Park and in the state highway easement is characterized as a single-file foot/hoof worn trail over pahoehoe. There are no kerbstones associated with this trail but it may have petroglyphs and cairns. With the thickness of the fountain grass and haole koa, relocation of the trail may not be easy; however, this lack of discovery does not mean that the trail is not present. Trail 21588 is an important cultural feature, as the DEIS states in the Cultural Impact Study (Appendix K): "The need to revive mauka — makai trails was expressed, as well as the need to protect cultural and archaeological sites" This trail was an important

transportation route to and from Honokōhau Settlement, and falls under the Highways Act of 1892, HRS Chapter 264-1(b). This trail should have been located and must be preserved.

Response: Please see responses related to Trail 21588 on pages 10, 70 and 71 of this letter.

Section 4.3 Visual Resources
The DEIS does not provide a visual impact analysis of vertical structures proposed for the site on surrounding view-planes, including from within the National Park. This type of analysis is critical for public review and comment. Visual impact analysis is common and could have been accomplished with geographic information system software such as ARCMAP or AutoCAD Wire Frame Diagram for 3D display. No analysis was made or presented that takes into account the estimates of the proposed site grading heights (page 28) and height details of each building to reveal how each would be elevated above the current natural grade, or above a baseline of sea level. (see also comments in Section 3.4.4 and 4.1.2.1).

Response: Please see our responses related to visual impact analysis, proposed site grading heights, and height details of each building on page 14 of this letter,

Section 4.3.2 Visual Resources, Anticipated Impacts and Recommended Mitigation
The DEIS states (page 72) that the proposed Harbormaster Control Tower "will be visible from the ocean and the Kaloko-Honōkohau National Historical Park." No impacts of this structure are assessed in the document. In addition to being visible from the National Park, the building will block emergency and other required vehicular access to the 'Aiopio area in the National Park. No mention of potential impacts to the Ala Kahakai National Historic Trail is made. No alternatives to this structure are offered in the DEIS. For example, a reasonable, commonly used, and cost- effective alternative that was not examined is to install webcams in various locations at the harbor entrance. The DEIS fails to meet the requirement to include reasonable alternatives and mitigations.

Response: In the visual impact analysis, one view is from the north side of Honokōhau Harbor entrance channel. Please refer to Attachment 3 for text and graphics that analyzes visual impact from the Kaloko-Honokōhau National Historic Park.

Section 4.3.2 Visual Resources, Anticipated Impacts and Recommended Mitigation (continued)
Project lighting will also have a negative effect on visual resources and nightscape in the National Park. Light pollution of the night sky will interfere with visitor experience and evening traditional cultural practices. No impact analysis of light pollution, or its mitigation, to the National Park is made in the DEIS.

Response: Please refer to page 14 of this letter for a discussion on night light pollution.

Section 4.3.2 Visual Resources, Anticipated Impacts and Recommended Mitigation (continued)
The "400-foot buffer zone" (page 72) is offered as a mitigation for visual resources. The buffer itself must be clearly defined as to exactly what will occur and what will be excluded within this buffer. The NPS requested this clarification in our response letter to the EIS preparation notice (Appendix A) however, contrary to requirements in HAR 11-200-15 (D), no meaningful response with specifics was given or incorporated into the DEIS.

Response: The 400-foot buffer zone is clearly depicted in Figure D, Preliminary Concept Plan, and Figure E, Green / Open Space Plan. Improvements within this buffer zone will be limited to lateral shoreline public trails, mauka-makai access trails from the project site, and cultural or environmental-related improvements related to existing features within the buffer zone. No buildings or structures shall be built within the 400-foot shoreline setback area, with the possible exception of structures that are directly related to native Hawaiian cultural resources in the buffer zone and that are requested by JDI's cultural advisors.

Specific uses and delineated boundaries will be defined prior to submitting appropriate permit applications.

Section 4.3.2 Visual Resources, Anticipated Impacts and Recommended Mitigation (continued)
The buffer zone has unexamined impacts of its own. It is unclear what is meant by "cultural or environmental-related improvements" and how they will be constructed and managed. Also "culturally related structures" is not defined. No discussion in the DEIS is presented on the following: whether amenities (light, restrooms) will be in the proposed buffer zone; if any of the proposed pumping activities for deep ocean water will cross the buffer (i.e., pipes and pumping station); if there will be any landscaping and/or grading activities within the buffer; what fertilizer and/or pesticide/herbicide use is proposed in this area; how the trail system will be constructed; if utilities trenching will be allowed and if so, trenching may impact archeological sites and features. No discussion exists of how public use at Alula Beach will be directed and regulated (i.e., if there will be lifeguard towers constructed, trash receptacles, recycling, etc). None of these potential impacts to resources in the buffer zone are addressed in the DEIS nor are mitigation measures offered.

Response: JDI will actively solicit community participation in the planning and implementation of specific structures related to native Hawaiian cultural resources within the buffer zone. Specific uses and activities will be defined prior to submitting appropriate permit applications, such as a Conservation District Use Permit application.

Section 4.4.2 Noise, Anticipated Impacts and Recommended Mitigation
The DEIS states that project generated noise will not impact adjacent properties as they are "mostly vacant or industrial" (page 73). However, Kaloko-Honokōhau National Historical Park is an adjacent neighbor and impacts to Park visitors and Hawaiian practitioners are not discussed.

Furthermore, resident and locally migratory (endangered) waterbirds, marine mammals and sea turtles will also be impacted by the noise and light generated by the project.

Natural soundscapes are an essential facet of the National Park experience. Visitors come to the Park to learn about the cultural and natural resources of the area, to experience, see and hear what the people of the Honokōhau Settlement might have seen and heard during daily life in a Hawaiian community. Hawaiian practitioners come to practice their culture in an appropriate setting, unhindered. Some visitors come just to experience a "spirit of place," solitude, inspiration, and relaxation. A cultural live-in center, to be established in the Park, is a central component of the National Park's mission and will be affected by the unmitigated 11-15 years of construction noise and dust associated with this project.

Prolonged construction time (up to 15 years) will impact visitors driving on Kealakehe parkway to the Park (and may deter them), will impact visitors and practitioners in the Park and cultural live-in center, and will impact the quality of interpretive programs and the experience of visitors in the southern area of the National Park. These negative impacts are not considered in the DEIS. Construction noise occurring from development on the Park's northern boundary is already impacting Park programs and individual visitors.

Response: The following text has been added to the EIS in Section 4.4, Noise, to identify noise impacts on the Kaloko-Honokōhau National Historic Park.

Noise impacts on the Kaloko-Honokōhau National Historical Park may result from construction activities over the duration of the 15-year construction period. However, only a small portion of the construction activities will occur in proximity to the park's property line. Additionally, construction activities must comply with requirements set forth in the State Department of Health noise permit.

On a long term basis, noise impacts on the Kaloko-Honokōhau National Historical Park may result from the existing Honokōhau Boat Harbor and adjacent industrial uses. Industrial and mechanical activities must comply with the State Department of Health Maximum Permissible Noise limits at the property line. Noise from the new marina may be audible but the project will comply with noise regulations to ensure that noise will remain within permissible levels.

Section 4.4.2 Noise, Anticipated Impacts and Recommended Mitigation (continued)
A 300% increase in vessels entering and exiting the harbor is an additional noise impact to visitors and practitioners on the shoreline that is not considered in the DEIS. Figure R illustrates that long term noise will be closest to the National Park.

Response: The DEIS statement that the "new marina will result in an approximately three-fold increase in boat traffic" is inaccurate and the phrase was deleted from the EIS text. Although the new 800 slips would increase the marina wet slips three-fold, over half the entrance channel traffic volume during peak hours is generated by the existing marina launch ramp.

In terms of noise impacts due to boat traffic, the following text has been added to Section 4.4, Noise:

Regarding noise generated by boats, regulations on boat noise is not currently enforced in the State of Hawai'i. Many states have approved a version of the SAE (Society of Automotive Engineers) J1970 or J2005 Standard which places restrictions on the operation of motorboats that exceed certain noise levels.

One restriction states that motorboats should not be operated in such a manner as to exceed 90 dBA when subject to a stationary sound level test (i.e., measured 1.5 meters away from the idling boat). These noise levels were applied to the existing background levels measured at the Kona Kai Ola project site. Assuming that boats entering and exiting the Honokōhau Marina are in compliance with this regulation in that they emit 90 dBA or less in idle, boat noise for noise receivers more than 150 meters (492 feet) from the channel is equivalent to or less than daytime background noise levels.

Noise receivers within 150 meters from the channel will be subject to noise levels in excess of daytime background noise levels. However, boat noise can be defined as a single noise event that is measured over the time interval between the initial and final times for which the sound level of the single event exceeds the background noise level. The noise generated by these single boat noise events takes place currently at the marina and is not expected to increase in the future.

The frequency of single boat noise events is expected to increase proportionally to the increase in boat traffic due to the proposed project Although the noise generated by a single boat event remains the same, more of these events will occur within a given time period. It is expected that noise levels within 150 meters of the marina and the channel to increase by up to 5 dB. In that a change of 3 dB is generally considered barely perceptible to the human ear, and an increase of 5 to 6 dB will be noticeable, but is not a significant noise impact.

Figure R, Noise Measurement Locations, which is re-designated Figure V, does not illustrate that "long term noise will be closest to the National Park." "L1" indicates the location of a long term measurement site, where continuous, hourly, statistical sound levels were recorded for 24 hours. As indicated in the Environmental Noise Assessment Report in Appendix N, the dominant long-term noise at this location was attributed to intermittent vehicular traffic on Kealakehe Parkway and wind. The dominant secondary noise sources included industrial and marina activities and occasional aircraft flyovers.

Section 4.4.2 Noise, Anticipated Impacts and Recommended Mitigation
No sound monitoring stations were established in the National Park to collect baseline data and analyze impacts. The DEIS does not include information and analysis concerning impacts from construction activities such as blasting, pile driving, and grading; impacts from a 300% increase in audible vessel traffic; and stationary sources such as the ocean water pumping equipment on Park visitors, cultural activities in the Park, interpretive and education programs in the Park, and sensitive resources including protected species.

Response: A long-term noise measurement site was located directly across the harbor which is fronted on the other side by Kaloko-Honokōhau National Historical Park.

A discussion of noise impacts related to construction blasting is contained in Section 4.4.2, Anticipated Impacts and Proposed Mitigation. A discussion of noise impacts related to boat traffic is contained on the previous page. A discussion of stationary mechanical equipment is contained in Section 4.4.2.

Section 4.5.4.3 Project Compatibility with Existing and Emerging Community
The National Park (Ala Kahakai is not mentioned here, but should be) is incorrectly placed under the "Short-Term Compatibility with Neighboring Uses" section. In fact, the National Park Service is charged with protecting Kaloko-Honokōhau in perpetuity, that is, "to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations (16 USC 1). Significant long-term adverse impacts and reasons for long term incompatibility between the National Park and a development of this magnitude are discussed in detail multiple times elsewhere in these comments. The long-term section does not discuss potential long term environmental or cultural consequences in any context. The no action alternative should be addressed here as well as throughout each section of the document.

Response: This section summarizes as analysis of issues identified in community interviews conducted as part of the Social Impact Assessment (SIA), as contained in Appendix O. The term "short term" is used to address project compatibility with neighboring uses. This is differentiated from "long term," which is used to discuss the project's relationship with the future character of Kona.

The two immediately adjacent parcels makai of the highway were the Kaloko-Honokōhau National Historic Park and the Queen Liliuokalani Trust Conservation District Area. The information contained in this section is intended to summarize findings from interviews conducted with stakeholders in these areas. Its function is documentation and analysis of interview findings, and mitigation is proposed accordingly. More detail on interviews with staff of the Kaloko-Honokōhau National Historic Park is provided in the SIA Section 3.7.2, Kaloko-Honokōhau National Historical Park.

Section 4.5.4.3 Project Compatibility with Existing and Emerging Community (continued)
The DEIS states that one of the long term compatibilities of the project is its "Marine

Orientation" implying an "active interaction with the ocean" (page 81), yet no study has been conducted for the DEIS to support this compatibility. The DEIS does not include a study on the carrying capacity of the coastal waters for scuba diving and snorkel tourism, whale and dolphin watching, or fishing charter boats, although it can be expected that these industries will grow with a triple-fold harbor increase.

Response: As stated in the Market Study, Economic Impact Analysis and Public Costs / Benefits Assessment of the Proposed Kona Kai Ola Community (Appendix C-1), "West Hawai'i has a long-established reputation as one of the world's finest sports fishing areas, and fishing / boating are deeply entrenched in the local culture and among residents." The market study found a high demand for additional boat slips and more marina-related facilities. Further, in community meetings from November 2005 through June 2007, ocean-related themes were common. This characteristic was confirmed in SIA interviews with both general community stakeholders and marine and shoreline users.

Section 3.9.3 provides a full discussion of marine fishing impacts in terms existing conditions and anticipated impacts as related to marline and tuna / pelagic fishery, coral reef from extractive fisheries and SCUBA, and the following text has been added to that section:

Impacts on Marlin and Tuna / Pelagic Fishery

The impact on the marlin and tuna fisheries from increased harbor capacity will be a function of the number of new boats in the harbor targeting these fisheries and the ability of these new boats to attract paying customers. Both marlin and large tuna fisheries have been shown to be in general decline according to private, state, and national fisheries statistics. There are several hypothesized causes for these declines relating primarily to international fisheries. The ability of the State to manage these pelagic marine fish stocks is limited by the national and international fishing policies.

Fisheries management typically attempts to reduce fishing pressure by limiting access to the fishery either through licensing, gear (boat) restrictions, catch limits, season or area limits. Limiting the number of boat slips available would not by itself provide effective control over fisheries pressure because these pressures are market driven, as well as for recreational and subsistence purposes, and there are other methods, such as boat launch ramps, to access the fishery.

Impacts on Coral Reef From Extractive Fisheries

It is possible that a large number of boat slips in the expanded harbor will be occupied by resident-owned motor boats for personal use. Private boats in Hawai'i are used for a variety of activities that have historically proven difficult to regulate. These may include extractive activities such as bottom fishing, trolling, spear fishing, tropical fish and invertebrate collecting, as well as non-extractive activities including sport diving, skiing, paragliding, racing, or shoreline transportation. Each of these activities has individual existing impacts upon marine resources and these impacts are expected to increase with the new harbor unless appropriate management is initiated.

There is a general perception that the increased access to nearshore resources will result in a decline in these fish stocks similar to that seen historically on O'ahu. This perception is not without merit and deserves serious attention from resource managers. However, the increased access to the shoreline has already occurred, and will continue as the coastline is developed regardless of harbor development. As most fisheries are market driven, as well as for recreational and subsistence purposes, there will be increased pressure on these resources in the future regardless of harbor development. Fisheries managers need to take a serious look at management strategies for the future. Attempting to preserve fisheries resources only by limiting the size of the harbor is not likely to have any positive long term effect on the nearshore living marine resources because there are increasingly other avenues to access the shorelines.

SCUBA

An increase in the number of boat slips is likely to cause an increase in both the number and size of commercial moored vessels offering dive tours as well as private boats used for diving. Although all of the dive sites in Kona are relatively near shore, the lack of shoreline access and ease of entry by boat makes boat diving the preferred option. As more of the Kona coast becomes developed however, this shoreline limitation to dive sites is likely to decrease. Attempting to limit dive pressure on the reef by limiting the number of available slips is not by itself an effective long-range management tool. As the number of divers on the reef increases, the pressure on the reef from anchor damage, extractive fisheries, and unintentional diver induced coral damage will likely increase. The increased pressure on dive sites from SCUBA divers must be met with commensurate changes in management to limit adverse impacts.

Proposed Mitigation

An increase in the harbor size offers the opportunity to consolidate, focus, and fund management and enforcement activities at one centralized location. The pressure on fish and invertebrate stocks, as well as upon populations of marine mammals and turtles can be expected to increase as the Kona population increases, regardless of whether the harbor is improved. The following changes could be made by DLNR, paid for at least in part by the additional revenues to DLNR from the Kona Kai Ola project. These changes are in the management authority of the DLNR Division of Aquatic Resources and the DLNR Division of Boating and Ocean Recreation.

- Increase in the number of fisheries enforcement and management personnel in Kona at one centralized harbor location
- Allocation of slip and office space for fisheries personnel and equipment
- Increased numbers of submerged mooring buoys (presently approaching 100) at all dive sites,
- Increased education materials for recreational divers and fishermen
- Initiate restrictions on the quantity and size of boats in each commercial sector
- For inshore species, initiate catch restrictions in line with Division of Aquatic Resources guidelines that prioritize recreational fishing above commercial fishing, and subsistence fishing above recreational fishing.

Section 4.5.4.3 Project Compatibility with Existing and Emerging Community (continued)

Another concern is that in the private marina there will be no state control over commercial businesses. A jet-ski, or personal watercraft, rental operation in the new marina would likely result in high use of these craft in Park waters. These craft and their associated noise (both in air and underwater) are highly incompatible in the short and long-term with the mission and purpose of the National Park and the cultural land- and seascape, and are incompatible with the local populations of resting dolphins and marine turtles. This potential impact should be mitigated by disallowing such businesses in Honokōhau Harbor. Furthermore, the increase in long-range yacht traffic may lead to the introduction of alien species. The west coast of Hawaiʻi Island is one of the only coastlines in the Main Hawaiian Islands that has not been invaded by alien species, which have caused great ecological and economical loss elsewhere (Waddell 2005). The DEIS does not address these impacts or offer mitigation.

Response: Marina management and related rules will be developed as the project progresses and with participation by area boaters and ocean users.

Section 4.8.2 Marina Traffic Study, Anticipated Impacts and Recommended Mitigation

See comments on Section 3.9.1.3 regarding tidal prism and navigation hazards. This section assumes only one type of vessel using the harbor. No assessment is made of impacts to human powered craft (canoes, kayaks) from increased vessel traffic.

Response: The boat traffic study does address multiple user types in the harbor, including hand-launched craft. The detailed boat traffic counts in the harbor entrance channel included these vessels as demonstrated in Figures 3-1 through 3-6 (itemized as vessels under 15 feet in length) of Appendix Q-1, Marina Boat Traffic Study. Thus, impacts are considered because they are a component of the total entrance users, and therefore impacted by the Level-of-Service in the channel. This study also included an interview with a board member of the Hawaiʻi Island Paddlers Association regarding their usage patterns and traffic concerns when traversing the entrance channel. Regarding impacts of increased traffic on paddling activities, fortunately for their shallow draft and maneuverability, they can navigate closer to the channel edges during peak traffic, assuming safe wave conditions. With this ability, they can reduce traffic impacts on their activities. Improving education and awareness among harbor users is also encouraged in the boat traffic study.

Section 4.7 Vehicular Traffic
As noted in the DEIS the existing traffic conditions are currently highly impacted and the project will further add congestion. Park visitors use these roads to access the Park and traffic contributes to their overall park experience. The Kealakehe Parkway intersection currently "operates at AM and PM peak periods at LOS F' (page 90). This is the worst level of service rated in traffic studies and it appears the project will increase the impacted situation: "There are increased delays anticipated at all intersections during the AM and PM peak periods compared to delays expected without the project" (page 92). In addition, the DEIS notes potential mitigations but provides no guarantee of implementation and does not include a property map to identify whether the mitigations are achievable within existing right-of-ways. Parking locations in the development are also not identified.

Response: The statements you quote are provided to identify existing conditions and fully disclose project impacts. Subsequent to those statements is Section 4.7.7, Anticipated Project Impacts and Proposed Mitigation. A full complement of mitigation measures will address project impacts, as well as improve the regional roadway system. A major project-related mitigation measure is the extension of Kuakini Highway through the project and to Makala Boulevard. This will provide an alternative roadway to Queen Kaahumanu Highway that will benefit the regional community. There is also a recommendation to improve the intersection of Kealakehe Parkway and Queen Kaahumanu Highway with a reconfiguration of the lanes that will alleviate traffic buildup.

The level of detail you request related to right-of-ways and parking locations will be provided as the developer continues to consult with transportation officials and the project progresses through the permitting process.

Section 4.9 Trails, Bike Paths and Pedestrian Access
The DEIS does not acknowledge that the Ala Kahakai NHT is intended for the preservation of ancient and historic trails, and routes for management and use by the public with landowner's consent. There may be modern connector trails that link ancient and historic trails and routes. The Ala Kahakai's purpose was not stated and differentiated from modern bike paths and sidewalks in the DEIS.

Response: The project developer fully intends that Kona Kai Ola support the development of the Ala Kahakai NHT as it relates to the proposed onsite trail system. To support the Ala Kahakai NHT system that is currently being developed, the project will connect pedestrian trails that connect to the project site from neighboring lands as a way to help create a trail system that could be part of the historic system, as well as to implement a bike path, trail system and sidewalk system to encourage these activities.

Section 4.10.5 Drainage and Storm Water Facilities

The DEIS states that "The storm drainage facilities designed for the site will take advantage of the porosity of the existing rocky landscape and the minimal slope, through the use of grading and thy wells, per County requirements" (page 100). The DEIS offers no further details on the site design of stormwater system, the discharge points for 10-yr and 100-yr stormwaters, or impacts to receiving water bodies. County and state stormwater requirements are not designed to protect ecosystems, only drinking water. The drywell system is no more than a hole in the ground and offers no additional protections to groundwater. No innovative sustainable or "green" solutions or BMP's are explored in the DEIS for stormwater runoff control and the removal of pollutants. No alternatives are given in the DEIS. For example the alternative of installing a stormwater line to the wastewater treatment plant is not analyzed. (See related comments on sections 3.4 Natural Drainage and 3.8.2 Surface Water).

Response: In addition to complying with public regulations, the project will incorporate BMPs to mitigate drainage and stormwater impacts. As an alternative to directing runoff into the ground through drywells, storm water should be directed into bioretention areas such as constructed surface or subsurface wetlands, vegetated filter strips, grass swales, and planted buffer areas. Storm water held and moved through these living filter systems are essentially stripped of most potential pollutants, and allowed to slowly infiltrate back to the groundwater table.

Section 4.10.6 Waste Water Facilities

The impacts and mitigation measures for wastewater are not complete. The DEIS makes no estimate or calculation of the increase in wastewater effluent that would be generated by the combination of uses of the final project at full capacity and does not evaluate whether the Kealakehe Waste Water Treatment Plant (WWTP) can accommodate the project in addition to those waiting to go on line now and in the future from projected development in the North Kona region. It is stated that the plant currently treats to R2 (secondary treatment) and could potentially have a 7.8 Mgal/d capacity (page 101), but no value for the requirements of the full project is stated. It is possible the project will nearly double the current 1.8 Mgal/d of wastewater received by the WWTP and put a strain on its 20-year design capacity of 5.3 Mgal/d. If the proposed development pumps its wastewater to the WWTP for treatment, it will significantly contribute to its own groundwater contamination by increasing the loading to the wastewater disposal sump. A suggested mitigation is to recycle R1 water on site, but the plant would need an upgrade and no discussion of upgrade is mentioned in this section. Page 122 suggests that upgrades to the plant will be required to bring it to R1 and possibly (but not stated) to increase the capacity, but it is not stated who will be required to fund the improvements, how the upgrades fit in to the project phasing, and if the Master Plan scheduling is considered in the project phasing. These details are not included and explained clearly in the DEIS. Although the use of recycled water for irrigation would save water (page 102), using treated sewage so close to the groundwater and marina would likely add to the nutrient load exiting the harbor mouth. These additional nutrients and their impacts are not addressed in the DEIS.

Response: The following indicates revisions to Section 4.10.6, Waste Water Facilities, in response to your comments:

Anticipated Impacts and Proposed Mitigation

The project design peak flow is estimated at a total of 5.7 mgd. Given the current flow of 1.8 mgd to Kealakehe WWTP, the total flow to the plant would reach 7.5 mgd. Currently, the Kealakehe WWTP has a design capacity of 5.3 mgd, and capacity would increase to 7.8 mgd with the activation of a sixth lagoon that remains vacant and undeveloped. Accommodation of the proposed project would require activation of the sixth lagoon.

In addition, the following text is added to address future County-initiated improvements and the developer's intent to participate in funding improvements:

Project-related impacts will be discussed with the County of Hawai'i in the development of the North Kona Sewer Master Plan and specific plans for the Kealakehe WWTP. The developer will make its fair share contribution to the improvements at the Kealakehe WWTP.

Further details on timing in project phasing will depend on the County's implementation schedule.

Nutrients impacts on groundwater and harbor water quality have been previously discussed in this letter.

4.10.8 Potable Water Facilities
The source of water supply for the Kona Kai Ola project demand needs to be identified in the DEIS to be able to adequately assess project impacts to groundwater supply, flow to coast, and proximal environment. The DEIS indicates it will need to secure water quantities estimated at 2.6 million gallons per day (maximum daily demand). That is the residential design equivalent of serving 26,000 people per day (100 gpd/person) for all kitchen, laundry, bathing, sanitary, and other uses around the home, and also represents 7% of the 38 Mgal/d total estimated sustainable yield from the Keauhou aquifer. The likelihood of obtaining 2.6 Mgal/d without significant impact to the subsurface and possibly the marine characteristics is low. The DEIS also indicates the Department of Water Supply (DWS) sources are not adequate to support the project needs, A plan to secure water quantities for the proposed development is not complete. As a result, the impacts to the National Park and mitigation measures have not been adequately addressed in this DEIS.

Response: Please refer to our response to your comment on water requirements on page 14 of this letter.

4.10.10 Water Features and Lagoons
The DEIS fails to justify the need for the proposed lagoons, nor are there meaningful mitigation actions or any alternatives provided in this section. These water features will have significant adverse direct and indirect environmental impacts including construction noise and air quality impacts, using large amounts of building/lining materials, using large amounts (undisclosed) of energy to pump 75 mg from the ocean daily, and degrading the water quality in the nearshore area of the National Park. The water feature may divert the existing local marine tourism economy from guided snorkel and scuba diving tours, rather than expand it. The ocean fronting the proposed development contains ample turtles, rays, and sharks. Therefore it is unnecessary to remove these animals from their natural habitat to use as displays, especially when the high environmental and energy costs required for the creation of these lagoons is considered.

The project proposes to include shark, turtle and ray lagoons on site, (page 106) yet no federal permit is listed in Section 5.3 for captive protected species (turtles).

Response: We acknowledge your preference for certain forms of enjoying marine animals. However, as evidenced in other areas along the West Hawai‘i coast, people enjoy both natural and created settings in experiencing interaction with marine animals. Rather than “divert the existing local marine tourism economy from guided snorkel and scuba diving tours,” Kona Kai Ola will provide a recreational option for residents and visitors. Other impacts you discuss in this comment are addressed in other parts of this letter.

4.10.10 Water Features and Lagoons
The DEIS states that “This [high volume of sea water flowing through the lagoons] will improve the water quality and will be a positive impact on the nearshore marine environment.” (page 106). The DEIS uses this statement misleadingly (see extensive comments on section 3.9.1.3) and does not reveal all impacts. Studies off shore of major developments on the west coast of Hawai‘i Island have shown an increase in nutrient concentrations (Wiegner et al 2006). Additional nutrient load will further degrade the nearshore water quality of West Hawai‘i.

Response: Please refer to our responses to several of your comments on pages 47 to 50 that discusses impacts related nutrient loading.

4.10.10 Water Features and Lagoons (continued)
The description of the drilling and placement of the pipes should include a detailed map that shows the proposed location of the pumping station for the SWAC and lagoon system as well as a bathymetric map outlining the location of the intake pipes. The potential impacts of the pumping stations, sea water intake, and piping system need to be included in the DEIS. Additionally, the noise impact study does not evaluate the noise impacts from the pumping station.

Response: Available information on the proposed SWAC facility is summarized in this section and a full discussion is presented in Appendix K, Cooling Water Intake Analysis (formerly Appendix J). Information related to the overall system process, water intake process, system infrastructure, possible impacts and mitigation measures in contained in both the EIS and the report. The level of detail you are requesting will be available in applications for permits, including a Conservation District Use Permit.

Noise generated by stationary mechanical equipment, such as a pumping station is discussed in Section 4.4, Noise.

4.10.10 Water Features and Lagoons (continued)
No cited references or data are presented to support the statement (page 107) that “the water quality [at 150-200’ depth]... is both high and relatively constant over the course of a year.” (see comments on Section 3.9.1.3) In the discussion of temperature of the water for the lagoons, (page 107) it is stated that “It is essential that the water be kept cool at all times” to prevent the growth of algae, parasites, and pathogens.” However, such required cool water may not be attractive to the tourists for whom these features are created.

Response: The water quality data for this purpose was obtained form nutrient measurements conducted for Ocean Thermal Energy Surveys at Keahole Point. These studies were conducted in 1982. Data collected for depths of 0 to 100 meters were obtained for this report. The average value from several measurements made over 9 months was used in the report. In addition, water quality samples were obtained during the Water Quality and Marine Biological Baseline Studies and Impact analysis several water samples were obtained from 100 to 200 foot depth. These results are shown in Appendix H-1. The total nitrogen concentrations from the two data sets were similar. The average values were used in the analysis to determine impacts. Wave disturbances are low at this depth and water quality variations in groundwater or surface water has no impact due to the depth. This causes water quality to be more stable than at the surface.

The water temperature at this depth is about 1 to 2 degrees Celsius cooler than the surface. The pumping and solar heating will raise the water temperature during the flow from the sea and through the lagoon. The water will flow out at ambient surface temperature after this heat gain. This slight coolness will not be uncomfortable and probably will be an added advantage as the area is hot most of the time.

4.10.10 Water Features and Lagoons (continued)
The DEIS incorrectly states (page 108, par. 3) that the outflow salinity will be "about 33ppt." According to page 46, par.1, the new outflow salinity will be 34.4 ppt, i.e., more dense (and will sink) from mixing with 75 Mgal/d of 36 ppt seawater.

Response: Water quality modeling has shown that, with a 400-slip marina, the water exchange will retain the existing two layer character at the mouth of the harbor. Under this condition, there will be a vertical salinity gradient both during flood and ebb tides. According to the three dimension modeling, salinity the entrance of the harbor varies from an average of 34.5ppt at the bottom to an average of 29.5 at the surface. However, it should be noted that high salinity bottom layer is thicker that the low salinity upper layers. The two layer salinity structure will be maintained and will not adversely impact benthic biota.

Section 5.1.1 Chapter 343, Hawai'i Revised Statutes
The DEIS states that "nutrient loading is lower than the present coastal waters" (page 108, par. 3). This statement is incorrect and contradicts the correct statement in the paragraph immediately preceding it (page 108, par. 2) stating that "the total amount [i.e. load] of nutrients that will be generated per day will increase." Moreover, at present the nutrients stay in the low-salinity upper layer. Slightly higher salinity and vertical mixing will make the constant high load of nutrients more available for benthic communities with resulting negative impacts. (see comments section 3.9.1.3).

Response: A three dimensional water quality model was used to determine in more detail the impacts of harbor expansion and the addition of outflow from the lagoon features. The water quality modeling report (Appendix U)shows that for a 400 slip marina, nutrient laden groundwater will be confined to the upper layers. The expansion of the harbor will not increase the total amount of groundwater flowing into the ocean in the area, but will redirect a larger fraction through the harbor. Although this will result in a more concentrated flow at the harbor entrance, the nutrients that are confined to the upper layer will not impact biota at the bottom.

Section 5 Conformance with Public Plans and Policies
The proposed Kona Kai Ola project does not comply with public plans and polices. An exhaustive discussion of each plan and policy is not included here as the significant points are made elsewhere in these comments. When necessary, specific contradictions to public plans and policies are discussed below. The DEIS does not comply with HAR § 11-200-17(11) because it does not reveal any conflicts or inconsistencies, nor describe a reconciliation with the plan or policy.

Response: We respectfully disagree with this comment. Section 5, Conformance with Plans and Policies addresses all plans and policies relevant to Kona Kai Ola.

Section 5.1.1 Chapter 343, Hawai'i Revised Statutes
The DEIS does not comply with Chapter 343 HRS and Chapter 200 HAR because the DEIS, as written appears to be pre-decisional, does not adequately review all proposed project components (e.g., "required" proposed marina size) or activities (e.g., SWAC and drinking

water sources), does not identify environmental impacts and their mitigation, does not evaluate any alternatives other than the preferred alternative, and does not adequately respond to comments received in the preparation of the statement. The document, as written, appears to "be a self-serving recitation of benefits and a rationalization of the proposed action" (HAE 11-200-14) in which potential impacts to the environment are downplayed throughout the report.

Response: The EIS for Kona Kai Ola contains full disclosure of project impacts on the natural and human environment. As discussed on page 2 of this letter, an alternatives analysis has been completed in response to agency and public comments and additional information generated as a result of inquiry into issues raised by the comments. Further, several studies were conducted in response to DEIS comments.

5.1.3 Coastal Zone Management Program, Chapter 205A, Hawai'i Revised Statues
The proposed project does not appear to comply with the CZM recreational resource policy B(i) age 112) to "Protect coastal resources uniquely suited for recreation activities that cannot be provided in other areas", nor does it comply with applicable portions of the Hawai'i State Plan sections 226-11 (page 119) and 226-23 (page 125) or Hawai'i County General Plan sections 2, 8, and 12 (pages 130,137,140). The nearshore areas adjacent to the Harbor mouth are rich with coastal resources including excellent dive sites, healthy coral reef, class AA coastal waters, important fish, dolphin, hawksbill, and green sea turtle habitat. These resources face irreversible adverse impacts under the proposed development. Furthermore, the DEIS did not complete a recreational analysis to examine current recreation patterns in the area and how these present uses will be impacted.

Response: The project complies with this CZM policy, and the EIS contains extensive studies to evaluate impacts related to coastal resources, water quality, marine mammals and sea turtles, and includes measures to protect these resources.

The DEIS covers analysis of recreation impacts in two studies. First, the Social Impact Study, which is summarized in Section 4.5, included community interviews with marine and shoreline users in particular. Findings related to these interviews are contained in Section 4.5.4.1, Issues Related to Marine and Shoreline Environment.

Second, the Marina Traffic Study includes an extensive evaluation of impacts related to adding up to 800 boat slips on navigation of recreational boat traffic within Honokōhau Harbor and the entrance channel. This study also included interviews, and harbor administrators and long time users provided information on the workings of the harbor, as well as insight on planning for future marina expansion.

5.1.3 Coastal Zone Management Program, Chapter 205A, Hawai'i Revised Statues (continued)
The proposed project also does not comply with the CZM historic resource policy C (page 112) to "support state goals for protection.. .of historic resources", nor does it comply with applicable portions of the Hawai'i State Plan sections 226-12 (page 120) or Hawai'i County General Plan sections 2, 6, and 14.7(e) (pages 130, 135, 143). The proposed development does not adequately protect historic resources. It appears that out of 182 sites (including 543 features) only 29 will be preserved (See section 4.2.2). The anchialine pools, endemic fauna, and native vegetation within this buffer "are an integral and functional part of Hawai'i's ethnic and cultural heritage" (HSP 226- 12) but will be irreversibly destroyed (see comments section 3.7.1.2 & 3.9.3.1).

Response: Kona Kai Ola complies with this CZM policy, as well as the sections you cite in the Hawaii State Plan and the Hawaii County General Plan. The basis for determining which archaeological sites would be further studied and preserved is the criteria outlined in the Rules Governing Procedures for Historic Preservation Review issued by DLNR. The criteria provide a management tool that addresses levels of significance and future action and preservation is normally considered for sites assessed as significant for more than one criterion. The sites recommended for preservation are consistent with these standards.

In additional studies conducted in response to DEIS comments, it was found that the DEIS finding that anchialine pools would be impacted by project-related groundwater changes is premature. The additional studies found that these changes may or may not impact biological communities in the anchialine and estuarine environment. In either case, the developer is committed to practicing good stewardship over the pools to be preserved, as well as flora and fauna in this area.

5.1.3 Coastal Zone Management Program, Chapter 205A, Hawaii Revised Statues (continued)

The proposed project does not appear to align with the CZM scenic and open space resource objective to "protect, preserve .. .or improve the quality of coastal scenic and open space resources" (Page 113), nor does it align with applicable portions of the Hawaii State Plan sections 226-12 (page 120) or Hawaii County General Plan sections 7, 8, and 14.8 (pages 136, 137, 144). Between the Queen Ka'ahumanu Highway and the shoreline, the development includes numerous 3 and 4 story structures on rock platforms that may be graded as high as 50 feet above natural elevations. Alternatives to the two-story Harbor Master Control Tower are not discussed (see comments section 3.3.4 & 4.3).

Response: Kona Kai Ola complies with CZM policies, as well as such policies in the Hawaii State Plan and the Hawaii County General Plan related to coastal scenic and open space resources. The discussion on Visual Resources in Section 4.3 has been expanded to include a visual impact analysis, which is attached to this letter.

The "two-story Harbor Master Control Tower" has been modified to a small one-story harbormaster observation hale.

5.1.3 Coastal Zone Management Program, Chapter 205A, Hawaii Revised Statues (continued)

The proposed project does not comply with the CZM coastal ecosystem policies C, D, or E which act to "Protect valuable coastal resources, including reefs, from disruption and minimize adverse impacts on all coastal ecosystems" (pages 113-114), nor does it comply with applicable portions of the Hawaii State Plan sections 226-11 and 13 (pages 119, 121) or Hawaii County General Plan sections 2, 4, 7, and 8 (pages 130, 133, 136, 137). The faunal/floral habitats will be destroyed in all anchialine pools and all vegetation in the 400-foot buffer will be impacted. The nearshore areas reefs and coastal resources face irreversible adverse impacts under the proposed development (see comments on section 3.9).

Response: Kona Kai Ola complies with CZM policies related to coastal resources and ecosystems, as well as those contained in the Hawaii State Plan and the Hawaii County General Plan. In additional studies conducted in response to DEIS comments, it was found that the DEIS finding that anchialine pools would be impacted by project-related groundwater changes is premature. The additional studies found that these changes may or may not impact biological communities in the anchialine and estuarine environment. In either case, the developer is committed to practicing good stewardship over the pools to be preserved, as well as flora and fauna in this area.

5.1.3 Coastal Zone Management Program, Chapter 205A, Hawaii Revised Statues (continued)
The proposed project does not comply with the CZM economic uses policy B, which requires that developments are "located, designed and constructed to minimize social, visual, and environmental impacts on the coastal zone management area" (page 114), nor does it comply with applicable portions of the Hawaii State Plan sections 226-11, 12, 13, and 104 (pages 119, 120, 121, 126) or Hawaii County General Plan sections 2, 7, and 8 (pages 130, 136, 137). For example, the artificial lagoon feature proposed purely for aesthetic and revenue reasons, will take up approximately 19 acres, and has the potential to greatly adversely impact water quality, water flow, cultural and natural coastal resources, and natural reef communities near the harbor mouth (see comments on section 3.9 and 4.10.10). Additionally, the DEIS does not adequately justify the need for the proposed project at the full-scale preferred alternative (see section 1.4).

Response: While the proposed project is consistent with CZM, Hawaii State Plan and Hawaii County General Plan economic policies related to minimized impacts in the coastal zone management area, Alternative 1 would lessen such impacts. In response to DEIS comments, alternative scenarios for Kona Kai Ola were analyzed. Alternative 1 features a 25-acre, 400-slip marina and 1,500 hotel and timeshare units. In this alternative, the water features would decrease from 19 to 5 acres. As noted on page 2, however, while it could be concluded that Alternative 1 is the preferable alternative, the DLNR agreement establishes the size of the marina at 45 acres and 800 slips. An amendment to the agreement is required to allow Alternative 1 to proceed, and this is an unresolved issue at this time.

5.1.3 Coastal Zone Management Program, Chapter 205A, Hawaii Revised Statues (continued)
The proposed project does not comply with marine resource policies A and B aimed to "promote the protection, use, and development of marine and coastal resources to assure their sustainability" (page 116), nor does it comply with applicable portions of the Hawaii State Plan sections 226-11, 12, 13, and 104 (pages 119, 120, 121, 126) or Hawaii County General Plan sections 2, 4, and 8 (pages 130, 133, 137). Seawater exiting lagoons and marina will not improve water quality; rather these features will very likely greatly degrade present conditions. It is unclear how the development intends to "improve fishery conservation" when it is contributing to an increase in the size of the fishing fleet (see comments on section 3.9.4).

Response: Kona Kai Ola is consistent with CZM marine resource policies A and B, and applicable portions in the Hawaii State Plan and Hawaii County General Plan. Various studies and the EIS have presented substantial information that indicates that project impacts on water quality will be mitigated.

The proposed marina may not contribute to an increase in the size of the fishing fleet. The proposed marina is meeting a current and publicly acknowledged need of the existing fishing fleet. Problems related to fishery conservation already exist. The EIS Section 3.9.3 discusses Marine Fishing Impacts.

5.1.4 Hawaii State Plan, Chapter 226, Hawaii Revised Statutes
2264 State Goals
The proposed project does not appear to align with Hawaii State goals of protecting the natural environment and fulfilling the needs and expectations of Hawaii's people. It does not "ensure that visitor industry activities are in keeping with the social, economic, and physical needs and aspirations of Hawaii's people." (HSP Section 226-8; page 118). According to Hawaii Tourism Authority's 2006 survey, 76% of Hawaii's residents agreed that "Even if more visitors come, I don't want to see any more hotels on this island," (Market Trends Pacific

2006). Many tourists presently visit the Honokōhau area to enjoy Alula Bay, popular dive sites, birding, fishing, Kaloko-Honokōhau National Historical Park and Ala Kahakai National Historic Trail among other activities. The proposed project may, in fact, degrade one of the key open space areas that draw tourists to Kona. In A Visitors View of Paradise: A Report on Maui '.s' Visitors... Why they come, What they enjoy, Why they return (Sierra Club 1998), 91% of tourists randomly surveyed reported that preservation of natural areas was very important to their decision to, return to visit and that they would like to see more "natural coastline." The proposed project will utilize enormous amounts of resources and energy, will place added stress on existing infrastructures, and will have irreversible adverse impacts on significant historical, cultural, and natural resources. Therefore it does not appear to be a "sustainable development" (see comments on Section 1.5.2).

Response: Kona Kai Ola is designed to be a mixed community offering facilities and amenities that would be enjoyed by residents and visitors alike throughout the development. Community-oriented features include various water features such as seawater lagoons with a marine wildlife park and a marine science center, a yacht club, fishing club, a canoe park, and a cultural park with a focus on Hawaiian maritime cultural heritage of the voyaging canoe. The coastal area would be protected with a shoreline park with trails and public access parking for walking and shoreline fishing, and a cultural park surrounding the heiau, the cultural sites and 'Alula for community use. Additional project community areas would include facilities and space for community use, including programs of the Kona Kai Ola Community Foundation, which supports community programs in health care, culture, education, and employment training for the local community, especially to native Hawaiians.

While the survey you mentioned suggest that Hawaii residents do not want to see more hotels, it is important to understand the full context of that statistic, and the following information has been added to Section 4.5, Social Environment:

> <u>Issues related to population growth are not unique to Kona Kai Ola. In 2002 and 2005, the Hawai`i Tourism Authority (HTA) included small "West Hawai'i" samples in its statewide "Survey of Resident Sentiments on Tourism in Hawai'i." Critical issues included cost of housing and traffic, followed by population growing too fast. The survey also found that almost everything – with the exception of availability of jobs – was more likely to be considered a "big problem" in 2005 than in 2002. The West Hawai'i results were similar to those from most other parts of the state.</u>
>
> <u>The survey also found an erosion from 2002 to 2005 in West Hawai'i resident support for tourism growth, belief in the overall benefits of tourism, although a majority still did feel tourism had brought more benefits than problems, and particularly in the need for more tourism jobs. Based on even earlier statewide survey results, the 2005 HTA report noted that resident support for expanded tourism employment is cyclical – it shrinks when tourism is strong (as at present) and then expands again when tourism has down times.</u>
>
> <u>In addition to the results shown in these two exhibits, the 2005 survey included a number of other questions. Several dealing with local government performance indicated a frustration with infrastructure overload from recent growth:</u>
>
> - <u>66% of West Hawai`i residents said government had done a "poor job" of building new infrastructure to keep up with growth in resident and visitor population.</u>
> - <u>45% gave government "poor" marks (vs. just 32% "good," and the rest unsure) for planning and controlling tourism-related growth.</u>

- <u>40% said "poor" (vs. 20% "good") for balancing the economic benefits from tourism against the need to control problems caused by tourism.</u>

<u>Thus, it appears that much of the negative sentiment toward tourism growth may be rooted in the current perception of infrastructure overload</u>.

5.2 County of Hawaii General Plan 14.7c
The Hawaii County General Plan 2005 for the DLNR portion of the development was amended from "Open" designation to "Urban Expansion Area" in 2006. The DEIS quotes the rational for the amendment: "The state plans to expand the harbor and have <u>some associated commercial</u> and golf course development surrounding the harbor" [emphasis added] (page 130). However, the proposed Kona Kai Ola project strongly diverges from this intended use and proposes to include three hotels, 1800+ timeshare units, and a 19-acre water feature with significant long-term adverse impacts to nearshore waters. Under Section 25-5-160 of the Hawaii County Code, the project site remains "Open" zoning. County rezoning should not occur.

<u>Response:</u> On November 29, 2006, the Hawaiʻi County Council approved the amendment to designate DLNR portion of the project as Urban Expansion Area. Kona Kai Ola is consistent with the Urban Expansion Area designation. The agreement between the developer and the State identifies hotel and time-share uses as possible development at Kona Kai Ola. The project is not a resort. A resort is a concept in which visitors are attracted to spend most, if not all, of their stay within the resort area through the design of amenities that fulfill the needs of a particular visitor market segment. This self-containment is achieved to varying degrees in resort development, depending on the natural, historic/cultural, and recreational resources within a resort site and the intended scale of the resort.

State and County laws recognize this distinction between a "resort" and a "hotel" or "time share unit." Section 514E-5, Hawaii Revised Statutes, authorizes time share units to be located in a resort area or any other area in which a county may by ordinance allow a hotel unit. The Hawaii County Code correspondingly permits hotels and time share units in non-resort zoning districts. The proposed project may include up to 700 hotel units and 1,803 time-share units, and depending on the eventual location of these project components, rezoning may be required for implementation.

5.2.3 County Zoning
Under Section 25-5-160 of the Hawaii County Code, the project site is zoned "Open". The proposed time-share and hotel units and commercial uses would not be consistent with this zoning designation. Rezoning should not occur.

<u>Response:</u> We agree that rezoning would be required to implement some components of the project. The decision to allow this rezoning rests with the County Council.

5.3 Permits Required for Project
Federal
U.S. Army Corps of Engineers Permit (Section 404)
U.S. Army Corps of Engineers Permit (Section 10)
Section 5.3 of the DEIS lists two Federal Permits that are required for the proposed project/undertaking. Federal Undertakings requiring National Environmental Policy Act (NEPA) and National Historic Preservation Act (NHPA) review are defined as:

> *"(y) <u>Undertaking means a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or on behalf of a Federal agency; those carried out with Federal financial</u>*

assistance; and those requiring a Federal permit,[emphasis added] license or approval" [36 CFR PART 800 -- PROTECTION OF HISTORIC PROPERTIES (incorporating amendments effective August 5, 2004)].

When the U.S. Army Corps of Engineers considers permitting the proposed project, it will be required to evaluate the effects under both NEPA and NHPA including effects on historic properties and consultation with the Advisory Council on Historic Preservation.

"Section 106 of the National Historic Preservation Act of 1966 (NHPA) requires Federal agencies to take into account the effects of their undertakings on historic properties, and afford the Advisory Council on Historic Preservation a reasonable opportunity to comment. The historic preservation review process mandated by Section 106 is outlined in regulations issued by ACHP. Revised regulations, "Protection of Historic Properties" (36 CFR Part 800), became effective January 11,2001, and are summarized below" [36CFR PART 800 -- PROTECTION OF HISTORIC PROPERTIES (incorporating amendments effective August 5, 2004)].

The Army Corps of Engineers must complete the NHPA Section 106 process before issuance of the Federal Permits

(c) Timing. The agency official must complete the section 106 process "prior to the approval of the expenditure of any Federal funds on the undertaking or prior to the issuance of any license [36 CFR PART 800 -- PROTECTION OF HISTORIC PROPERTIES (incorporating amendments effective August 5, 2004)].

Kona Kai Ola proponents including the State of Hawaii DLNR should be thoroughly familiar with NHPA Section requirements and realize that a State of Hawaii Environmental Impact Statement is not sufficient to proceed.

When the U.S. Army Corps of Engineers considers permitting the proposed project, it will also be required to evaluate the effects under the Endangered Species Act, requiring consultation with the USFWS and the NOAA-Fisheries.

Response: It is fully understood that an EIS is not sufficient to proceed. It is further understood that various permits will require a greater level of detail than required in an EIS. Section 5.3, Permits Required for Project, has been revised to include the table on page 7 of this letter that includes Army Corps of Engineers permits.

Section 7 Relationship between Short Term Uses of the Environment and the Maintenance of Long Term Productivity

This section does not meet the requirements of HAR § 11-200-17 (J), which states: "The discussion shall include the extent to which the proposed action forecloses future options, narrows the range of beneficial uses of the environment, or poses long-term risks to health or safety. In this context, short-term and long-term do not necessarily refer to any fixed time periods, but shall be viewed in terms of the environmentally significant consequences of the proposed action." The discussion in the DEIS does not adequately or realistically discuss any of these elements, including future actions foreclosed which involve the NHL and the National Park. The discussion in this section, as throughout DEIS, is entirely in a positive light rather than an impartial examination of the alternatives, impacts, and long and short-term gains and losses. Adverse impacts are treated superficially and downplayed. The statement that "The natural environment, including the shoreline environment will be altered but its long term sustainability, viability and productivity will be enhanced. " (page 153) is inaccurate, unfounded and unsupportable by the studies in the DEIS.

The statement that "The infrastructure improvements to the site, primarily the upgrades and subsequent hookups to the wastewater treatment plant will result in less effluent seeping into groundwater/nearshore waters from the temporary sump used for disposal of the effluent from the waste water treatment plant, as well as input via the septic systems used at the existing marina." (page 153) is also unfounded and confusing. Because upgrades to the WWTP are not described in the document, other than to state they will be needed (page 122), it appears that, if the proposed development pumps its wastewater to the Kealakehe Wastewater Treatment Plant for treatment, it will significantly contribute to its own groundwater contamination by increasing the loading to the wastewater disposal sump.

Response: We respectfully disagree with your assessment of the EIS compliance with HAR § 11-200-17 (J). The EIS is based on thorough and detailed studies that collectively provide the foundation for a balanced and objective analysis of overall impacts related to the development of Kona Kai Ola.

Adverse impacts were not downplayed. Rather, every effort was made to fully investigate issues raised in DEIS comments. Several additional studies were conducted to expand our understanding of existing conditions, identify project impacts and proposed appropriate mitigation measures. Additional studies are identified on pages 85 and 86 of this letter.

The tone of the EIS in not "in a positive light," as you assert. The theme throughout the document is to fully disclose all known impacts, and seek solutions that will effectively address project impacts.

Regarding upgrades to the Kealakehe Wastewater Treatment Plant, the County is currently preparing the North Kona Sewer Master Plan. The project will not "significantly contribute to its own groundwater contamination by increasing the loading to the wastewater disposal sump." The developer will pay its pro rata share of improvements, and the improvements will serve not just Kona Kai Ola but the entire service area. This is responsible statement, based on a realistic understanding of the existing situation.

Section 8 Cumulative Impacts
This section does not begin to adequately investigate and address the cumulative impacts of the proposed development as required by HAR §11-200-17(I). This section is an incomplete list of some of the development projects occurring in North Kona. Direct and indirect cumulative effects are not discussed for most of the resources affected by the proposed project as a result of cumulative actions. The C-17 SAAF construction at Keahole International Airport and increased daily military over-flights (flight paths including the harbor and nearshore area), the state highway expansion, the cultural live-in center at Kaloko-Honokōhau NHP, the TSA industrial park expansion, the comprehensive management plan/EIS of the Ala Kahakai NHT, and the intention of the Shores at Kohanaiki development to significantly impact local groundwater resources by installing eight wells for coastal golf course irrigation, are a just few of the projects in the immediate area that are not mentioned or considered. Cumulative impacts to noise levels (including underwater soundscape), viewscape, night sky pollution, endangered species, groundwater quantity and quality, anchialine pools, air quality, marine (natural and economic) resources, traffic, cultural and natural landscape, utilities infrastructure, etc., from the cumulative interactions of the projects listed above and others, are either not discussed or are only mentioned briefly. Past, present, and future conditions, projects, and their primary and secondary effects, positive and negative, are not described in the document for review so that the public may fully understand the cumulative impacts to resources by the addition to those of the proposed project. It is a critical component of the environmental review process that has been ignored in this DEIS.

Response: Section 8, Cumulative Impacts, has been revised to expand discussion on projects in the region, as follows:

Cumulative Impacts

In general, West Hawaiʻi is expected to continue to change with more urbanized uses being introduced to the region. West Hawaiʻi's population is forecasted to increase by 37 to 53 percent by 2020. It is expected that the economy will continue to be driven primarily by growth in the visitor industry and associated recreational real estate. West Hawaiʻi is expected to continue to attract most of the island's visitors. Visitor units and tourism related employment are expected to experience corresponding increases.

The project is located in the midst of major changes due to development, and the projects nearest Kona Kai Ola are as follows:

Kula Nei Project: Located approximately 2.5 miles northeast of Kona Kai Ola, the Kula Nei project is on approximately 150 acres. The Shopoff Group is proposing to develop the property for low density residential development which would consist of about 270 residential units of which up to 220 single-family home sites that would include affordable housing units. The project published its Environmental Impact Statement Preparation Notice in November of 2006.

Kaloko Heights: The proposed Stanford Carr Development project is on approximately 400 acres of land approximately two miles northeast of the Kona Kai Ola project. The proposed development is for 1,500 residential units including affordable and moderately priced homes, and would include a five-acre commercial project.

Palani Ranch: Currently in its conceptual long-range planning, the Palani Ranch Co., Inc. owns approximately 500 acres of land approximately 1.6 miles east of the Kona Kai Ola project.

Villages of LaʻiʻŌpua: Less than a mile east of the Kona Kai Ola project is the 1,015 acre master-planned community that would include about 4,000 plus single-family and multi-family residential units, recreational facilities, and community and neighborhood commercial complexes. DHHL owns approximately 980 acres within the villages. The project consists of 14 different villages. Villages 4 and 5 are the next phases of development and would create approximately 300 lots including single-family homes. Additional Villages are planned for the future.

University of Hawaiʻi Community Colleges: The University of Hawaiʻi Center at West Hawaiʻi is planning and designing of a University of Hawaiʻi Community Colleges on land just east of the Kona Kai Ola project.

West Hawaiʻi Business Park/Kaloko-Honokōhau Business Park: Lanihau Partners L.P. is proposing the development of approximately 330 acres of land just northeast of the Kona Kai Ola project. The proposed use of the site is for light industrial, business and commercial. Phase 1, 100 acres for industrial/mixed use and 100-plus acres for general industrial zoning use (quarry and related), and Phase 2, about 80 acres for industrial/mixed use, are estimated to be completed in 2012. Phase 3, about 40 acres designated for industrial/mixed use, is anticipated to start in 2011 through 2015 in conjunction with the Phase 2 development.

Kaloko Industrial Park, Phases III & IV: Less than a mile northeast of the Kona Kai Ola project is the approximately 233 acre Kaloko Industrial Park developed by TSA International, Limited. The proposed development is light industrial and industrial-commercial mixed use. Phase III and IV would consist of approximately 102 acres and will provide 82 lots. Phases I and II approximately 130 acres of area consisted of 85 lots been completed.

West Hawaiʻi Hospital: Planned Medical Community 21st Century is in the process of planning a new hospital on 35 acres immediately east of Kona Kai Ola project, in the Villages of Laʻiʻōpua Village 8. Construction is estimated to take place between 2008 and 2013.

West Hawaiʻi Civic Center: Located less than a mile east, the County of Hawaiʻi's West Hawaiʻi Civic Center is located on seven acres of County land located in the Villages of Laʻi ʻŌpua. The civic center would be the County's one-stop service center that would include meeting rooms, motor vehicle registration, driver's licensing, offices for Real Property Tax, Department of Planning, Department of Public Works, Office of Aging, the Mayor's Office, the County Council office, Liquor Control and the Department of Parks and Recreation. Construction for the first phase was to begin in 2006.

Palamanui Development: Located near the Kona International Airport at Keahole, the Hiluhilu Development LLC proposes to develop a 725.2 acre parcel northeast of Kona Kai Ola. Palamanui will provide approximately 845 housing units (residences for the University of Hawaiʻi's West Hawaiʻi Campus and the community), a cultural center, commercial areas, an 18-hole golf course, athletic fields and medical wellness facilities.

Queen Liliʻuokalani Trust: The Queen Liliʻuokalani Trust owns land south and southeast to the Kona Kai Ola project. The 3,500 acres of land is a mix of both developed and undeveloped lands. Undeveloped entitled lands include 100 acres of mixed use, light industrial and commercial zoned and 20 acres of general commercial zoned.

Kona International Airport at Keāhole: Located 3.4 miles north of the Kona Kai Ola project is the Kona International Airport at Keāhole on approximately 4,422 acres of land, of which about 322 acres are leased to the Natural Energy Laboratory of Hawaiʻi and 421 acres to the Hawaiʻi Ocean Science and Technology Park. Plans for the airport include runway expansions and additional support facilities such as public parking, postal facilities, warehouses, and other facilities to meet the airport's growth needs. Expansion construction is expected to continue into 2015.

Kalaoa/Airport Properties: DHHL has preliminary plans for approximately 483 acres of land three miles north of the Kona Kai Ola project. Preliminary plans based on the Hawaiʻi Island Plan included 230 acres for general agriculture use, ten acres for commercial use; seven acres for community use, 100 acres for industrial use, and 136 acres for residential use.

Lokahi Subdivision: Located approximately 1.5 miles northeast of Kona Kai Ola is the Lokahi Subdivision proposed development by Westpro Development, Inc. The proposed development on an area of approximately 68 acres of land would include 190 lots for residential with park and related amenities. .

Kohanaiki Golf and Ocean Club: A project by the Rutter Development Corp./ KW Kohanaiki, LLC., is on approximately 450 acres of land approximately 1.5 miles north of the Kona Kai Ola project. The proposal project includes up to 500 homes, golf course, and clubhouse.

In addition to development projects, there are several proposed infrastructure improvements, as follows:

- Water
    - North Kona Water Source Development, Transmission and Storage for the Villages of Laʻiʻōpua;

- <u>Palani Road to Keanalehu Drive Transmission Line for Villages of La‘i‘Ōpua;</u>
- <u>Kealaka‘a Street to Keanalehu Drive Transmission Line for Villages of La‘i‘Ōpua;</u>

▪ <u>Sewer</u>

- <u>Sewer along extension along Keanalehu Drive for Villages of La‘i‘Ōpua;</u>
- <u>Electrical Substation with in the Villages of La‘i‘Ōpua;</u>

▪ <u>Roads</u>

- <u>Keanalehu Drive Extension to Manawale‘a Street;</u>
- <u>Ane Koehokalole Highway Extension to Henry Street;</u>
- <u>Keanalehu Drive Extension to Palani Road;</u>
- <u>Kealakehe Parkway to Kealaka‘a Street Extension;</u>
- <u>Kealakehe Parkway / Queen Ka‘ahumanu Highway Intersection;</u>
- <u>Kealakehe Parkway Extension to Kuakini Highway;</u>
- <u>Queen Ka‘ahumanu Road Widening;</u>
- <u>Kamanu Street Extension to Kealakehe Parkway</u>

Section 9 Probable Adverse Environmental Impacts Which Cannot be Avoided

The summary of unavoidable adverse impacts is incomplete, downplayed, and in some cases misleading. For example, the statement that "Construction of the new marina will cause the removal of some anchialine ponds, as well as the change from brackish water to marine ecosystems in the remaining anchialine ponds makai of the new harbor" [emphasis added] is used or similarly phrased throughout the document (pages iv, 51, 119, 154, 159) and gives the false impression that some, not all, of the anchialine pools will be destroyed. The reader must be reading carefully to understand that as a result of the proposed project, all of the pools (which have national significance, a fact that is omitted) will be destroyed. Most of the adverse environmental impacts that are unavoidable resulting from this proposed project are not listed for the following resources: groundwater, coastal marine ecosystem, candidate endangered species and their habitat, endangered species, protected species, cultural and archeological resources including the fragmentation of the existing cultural landscape, and night sky pollution. Resources that are listed are treated in cursory fashion. This section of the DEIS is wholly inadequate.

<u>**Response:**</u> As discussed in various sections of this letter, of the 19 anchialine pools, three pools with a combined surface area of $20m^2$ would be eliminated due to the harbor construction. Further, studies conducted subsequent to DEIS publication indicate that there are mitigation measures already in practice that could be used at Kona Kai Ola to address project impacts on anchialine pools.

The DEIS contains substantial information on the areas you list that indicates that impacts to these resources can be effectively mitigated. A categorical statement that impacts to these resources is unavoidable is inaccurate.

Section 10 Unresolved Issues

Both the water demand for the development (2.6 Mgal/d) and the SWAC system have potentially significant long-term, irreversible negative impacts on the groundwater flowing through the National Park, These impacts are too significant to leave unresolved and should have been included in the EIS.

Response: The purpose of this section is to disclose information related to issues that would be resolved at a later date. It is not possible to resolve all impacts related to the SWAC system, as it is in the conceptual planning stage. The level of detail you imply will be developed in applications for permits, such as the Conservation District Use Area Permit.

Your comment letter and this response are included in the Final Environmental Impact Statement. We appreciate your participation in the environmental review process. Please submit a request to our office if you would like to receive a printed or electronic copy of the Final Environmental Impact Statement, or portions thereof.

Sincerely,

Dayan Vithanage, P.E., PhD.
Director of Engineering

cc: Office of Environmental Quality Control
State Department of Hawaiian Home Lands
Jacoby Development, Inc.

Attachment 1

2 Alternatives Analysis

~~In typical land development projects, the initial planning process includes the exploration of alternatives to development objectives. In the EIS process, these alternatives are presented with a disclosure of reasons for the dismissal of non-preferred alternatives.~~

~~Kona Kai Ola does not follow this same pattern of alternatives evaluation.~~ As discussed in Section 1.4, the proposed Kona Kai Ola project is the result of agreements between JDI and the State DLNR and DHHL. The agreements and leases between the State and JDI stipulate the parameters of development for this site in terms of uses, quantities and size of many features, resulting in a limited range of land uses. Unlike a private property project, JDI is required to meet the criteria outlined in the agreements, thereby affording less flexibility in options and uses. From the developer's perspective, the agreements must also provide sufficient flexibility to allow for a development product that responds to market needs and provides a reasonable rate of return on the private investment.

The agreements between JDI and DLNR specify that the proposed harbor basin is to be 45 acres and accommodate 800 slips. This development proposal is the subject of this EIS. In response to DEIS comments, additional water quality studies and modeling were conducted. These studies determined that the water circulation in a 45-acre 800-slip marina would be insufficient to maintain the required standard of water quality. The models of water circulation suggest that a new 25-acre harbor basin could successfully maintain required water quality in the new harbor. Comments on the DEIS from DLNR, from other government agencies, the neighbors and the general community also called for the consideration of alternatives in the EIS, including a project with a smaller harbor basin and less density of hotel and time-share units.

In response to these comments on the DEIS, three alternatives are evaluated in this Final EIS and include Alternative 1, which is a plan with a 25-acre 400-slip harbor basin including a decrease in hotel and time-share units; Alternative 2, which is an alternative that had been previously discussed but not included in the proposed project, that includes an 800-slip harbor and a golf course; and Alternative 3, the no-project alternative. Each alternative is included in the EIS with an evaluation of their potential impacts. These project alternatives are presented to compare the levels of impacts and mitigation measures of the proposed project and alternative development schemes pursuant to requirements set forth in Chapter 343, HRS.

~~JDI is required to provide a new marina basin not less than 45 acres and a minimum of 800 new boat slips. Further, the agreements provide the following options for land uses at the project site:~~

- ~~Golf Course~~
- ~~Retail Commercial Facilities~~
- ~~Hotel Development Parcels~~
- ~~Marina Development Parcels~~
- ~~Community Benefit Development Parcels~~

~~JDI is not pursuing the golf course option and is proposing instead to create various water features throughout the project site. All other optional uses have been incorporated in Kona Kai Ola.~~

2.1 Project Alternatives

2.1.1 Alternative 1: 400-Slip Marina

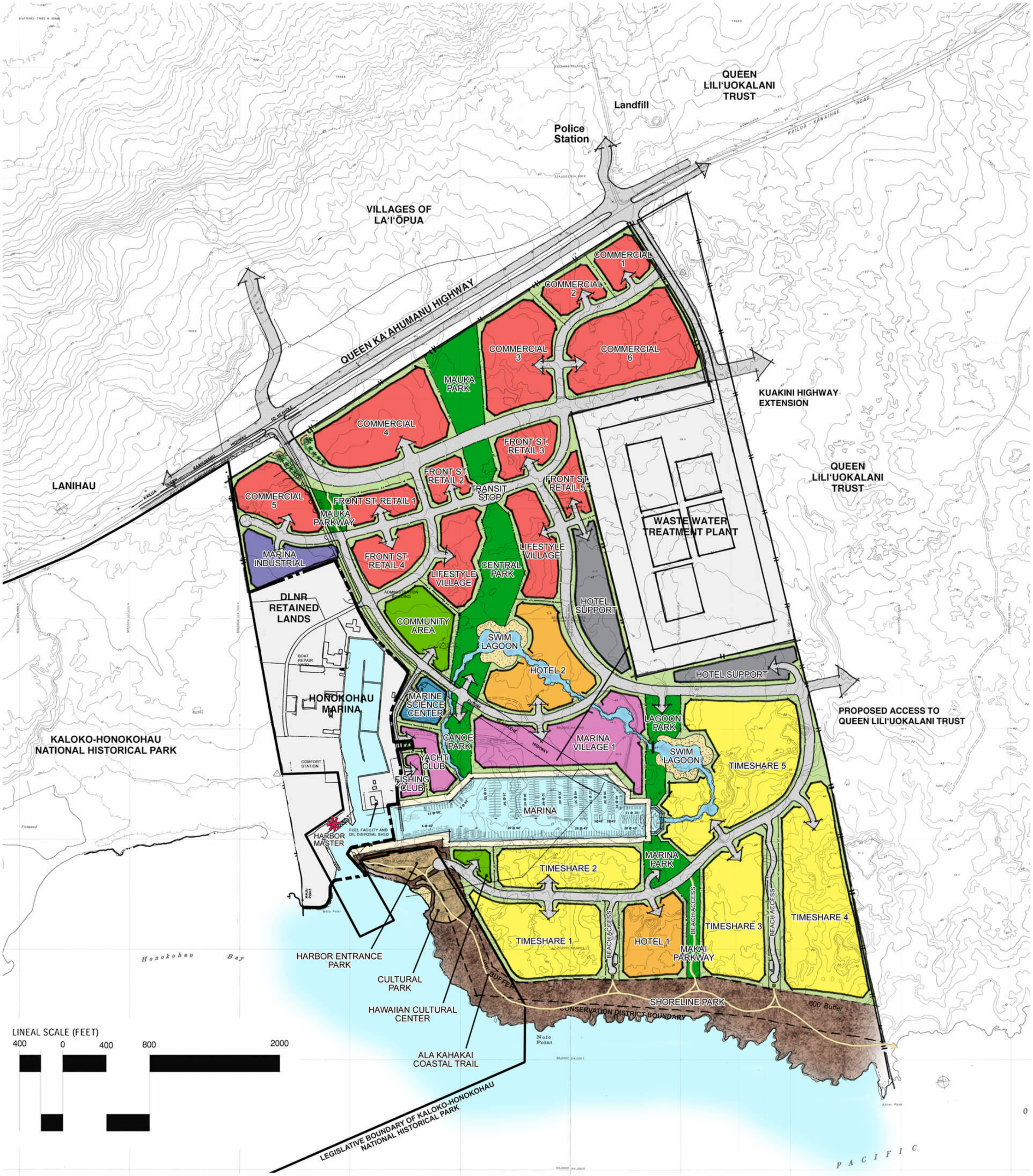
Studies conducted in response to DEIS comments found the construction and operation of an 800-slip marina may significantly impact the water quality within the marina and along the shoreline. Specifically, the Harbor Water Quality Modeling Study, as contained in Appendix U, found that the water circulation in a 45-acre 800-slip harbor was insufficient to maintain an acceptable level of water quality. Further, the existing harbor channel, which would serve both the existing and new harbors, could not adequately serve the increased boat traffic generated by an 800-slip marina during peak traffic. Mitigation measures to accommodate peak boat traffic included the widening of the existing channel, an action that would entail a complex process of Federal and State approvals and encounter significant environmental concern.

Concerns related to the proposed density of hotel and time-share units were also expressed in comments to the DEIS from members of the public, neighbors to the project site, especially the Kaniohale Community Association, and government agencies. Common themes in DEIS comments were related to impacts regarding traffic, project requirements of potable water and infrastructure systems, including sewer, drainage, utility and solid waste systems, and socioeconomic impacts.

In response to the water quality study results, and to the DEIS comments, an alternative plan was developed with a smaller marina with less boat slips, and a related decrease in hotel and time share units. Illustrated in Figure G, Alternative 1 reflects this lesser density project, and features a 400-slip marina encompassing 25 acres. For the purposes of the Alternative 1 analysis, JDI assumed 1,100 time-share units and 400 hotel rooms. Project components include:

- 400 hotel units on 34 acres
- 1,100 time-share units on 106 acres
- 143 acres of commercial uses
- 11 acres of marina support facilities
- 214 acres of parks, roads, open spaces, swim lagoons and community use areas

In addition, Alternative 1 would include the construction of a new intersection of Kealakehe Parkway with Queen Ka‘ahumanu Highway, and the extension of Kealakehe Parkway to join Kuakini Highway to cross the lands of Queen Lili‘uokalani Trust, and connecting with Kuakini Highway in Kailua-Kona. This is a significant off-site infrastructure improvement and is included in the agreements between the State and JDI.



Source: PBR HAWAII

Plan is conceptual only and subject to change

Figure G: Alternative 1: 400-Slip Marina

LEGEND

- TIME SHARE
- HOTEL
- RETAIL / COMMERCIAL
- MARINA RETAIL
- MARINA SUPPORT / COMMERCIAL
- MARINE SCIENCE CENTER
- COMMUNITY AREA / CULTURAL CENTER
- SWIM LAGOON
- MARINA
- UTILITIES
- PARKS & GREEN SPACE
- SHORELINE
- HARBOR ENTRANCE PARK / CULTURAL PARK

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innovation through engineering & scientific excellence

JDI
JACOBY DEVELOPMENT, INC.

Like the proposed project, Alternative 1 would have a strong ocean orientation, and project components that support this theme would include various water features including seawater lagoons and a marine science center. The new Alternative 1 harbor would include a yacht club, fishing club, a canoe park, and a cultural park with a focus on Hawaiian maritime cultural heritage of the voyaging canoe. The coastal area would be protected with a shoreline park with trails and public access parking for walking and shoreline fishing, and a cultural park surrounding the heiau, the cultural sites and 'Alula for community use. Additional Alternative 1 community areas would include facilities and space for community use, including programs of the Kona Kai Ola Community Foundation, which supports community programs in health care, culture, education, and employment training for the local community, especially to native Hawaiians. Like the original proposed plan, Alternative 1 includes 40 percent of the land in parks, roads, open spaces, swim lagoons and community use areas.

2.1.2 Alternative 2: Golf Course Feature

Alternative 2 was among the alternatives discussed at a community charrette in September 2003. It includes a golf course, which is a permitted use in the DLNR agreement and DHHL lease. As Figure H illustrates, an 18-hole championship golf course would occupy 222 acres on the southern portion of the project site. As with the proposed project, Alternative 2 includes an 800-slip marina on a minimum of 45 acres.

To support the economic viability of the project, other Alternative 2 uses include:

- Golf course clubhouse on three acres
- 1,570 visitor units on 88 acres fronting the marina
- 118 acres of commercial uses
- 23 acres of community uses

Community uses in Alternative 2 include an amphitheater, a canoe facilities park, a community health center, a Hawaiian cultural center and fishing village, a marine science center and employment training center. The sea water lagoon features contained in the proposed project and Alternative 1 are not included in this alternative.

2.1.3 Alternative 3: No Action

In Alternative 3, the project site would be left vacant, and the proposed marina, hotel and time-share facilities, commercial and marina industrial complexes, and community-oriented uses would not be realized.

~~The economic viability and sustainability of the project is determined by the density and uses proposed. Because JDI is obligated to develop an 800-slip marina for the State, complete road improvements, and provide various public enhancement features at its own expense, the density proposed for the income generating features of the development must be sufficient to provide an acceptable level of economic return for JDI. The market study, which is discussed in Section 4.6, reviewed various development schemes and determined that the currently proposed density and mix is the optimum to meet the anticipated financing and development cost obligations for the public features associated with the development.~~

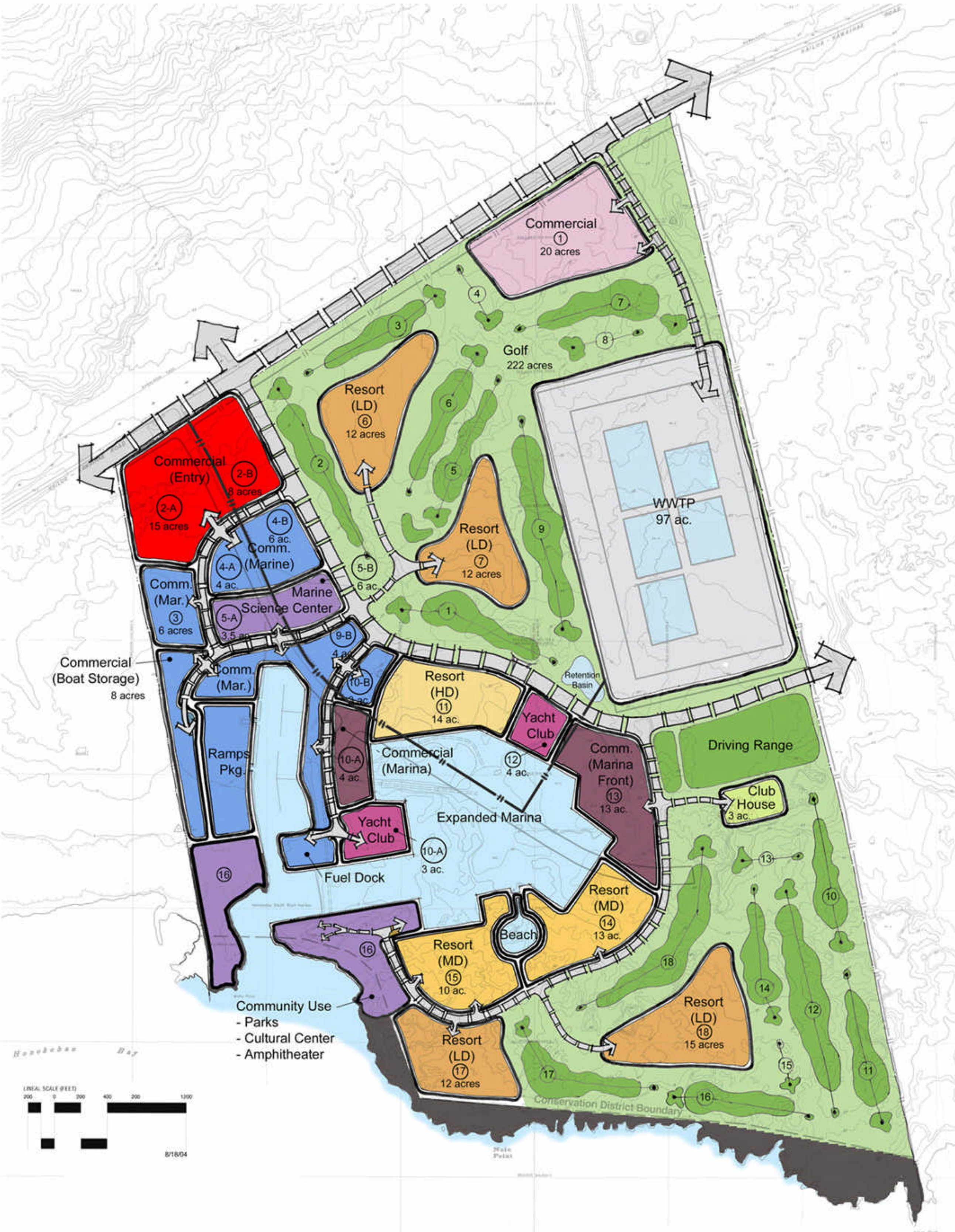

Figure H. Alternative 2: Golf Course Alternative

Legend

oceanit

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JDI

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2.2 Alternatives Analysis

As discussed in Section 2.1, the proposed Kona Kai Ola project (also referred to as "proposed project") is defined by development requirements related for a marina and the related uses that would be needed to generate a reasonable rate of return that covers development costs.

Beginning with Section 2.2.1, the alternative development concepts are comparatively assessed for potential impacts that may reasonably be expected to result from each alternative. Following is an overview of the primary observations of such assessment.

Alternative 1 includes half of the State-required boat slips and 60 percent of the proposed hotel and time-share units and, due to the decreased density, this alternative would generate significantly less environmental and socio-economic impacts. A harbor water quality model found the reduction of the volume of the new marina basin by about half (approximately 25 acres) significantly improved the water circulation and quality. Further, the reduced number of boat slips would generate less boat traffic, thereby reducing congestion and the need to mitigate impacts further by the widening of the existing harbor channel.

A project with fewer hotel and time-share units and increased commercial space with a longer (14 years) absorption period would change the mix of employment offered by the project, and slightly increase the overall employment count. The public costs/benefits associated with Alternative 1 would change, compared to the proposed project, with a general increase in tax collections, and a general decrease in per capita costs. Detailed discussion of Alternative 1 potential economic impacts are provided in Section 4.6.6. Comparisons of levels of impact are presented throughout this FEIS.

While this analysis might indicate that the 25-acre marina in Alternative 1 would be the more prudent choice, the DLNR agreement establishes the minimum size and slip capacity of the marina at 45 acres and 800 slips, respectively. Amendments to the DLNR agreement would be required in order to allow Alternative 1 to proceed as the preferred alternative. Hence, selection of the preferred alternative is an unresolved issue at the writing of this FEIS.

Alternative 2, the golf course alternative, was not previously considered to be the preferred alternative primarily because market conditions at the time of project development might not likely support another golf course. Further, DHHL has a strategy goal to have more revenue-generating activities on the commercial lease lands within the project area. In addition, concerns have been expressed as to environmental impacts of coastal golf courses, including the potential adverse impact on Kona's water supply if potable water is used for golf course irrigation.

While Alternative 3, the no-project alternative, would not generate adverse impacts related to development of these lands associated with the construction and long-term operations, it would also not allow for an expanded public marina that would meet public need and generate income for the public sector. Further, the no-project alternative would foreclose the opportunity to create a master-planned State-initiated development that would result in increased tax revenue, recreation options and community facilities. Crucial privately-funded improvements, such as the marina, regional roadway and circulation improvements, and improvements to the existing wastewater treatment plant, would not be implemented. Private funds toward the development of community-oriented facilities such as parks, other recreational facilities, and public access would not be contributed.

~~Hence, the only valid alternative to the proposed project is the no-action alternative. In this alternative, the project site would be left vacant, and the proposed marina, hotel and time-share facilities, commercial and marina industrial complexes, and community-oriented uses would not be realized.~~

~~The no-project alternative would therefore not generate adverse impacts associated with the construction and long-term operations would not occur.~~

~~Likewise, the creation of a master-planned state-initiated development, resulting in increased employment, tax revenue, recreation options and community facilities, would not be created. Privately-funded improvements, such as the marina, regional roadway and circulation improvements, and improvements to the existing wastewater treatment plant, would not be implemented. Private funds toward the development of community-oriented facilities such as parks, other recreational facilities and public access would not be contributed.~~

Further, the creation of revenue-producing businesses on the DHHL property to fund homestead programs would not occur, resulting in fewer potential benefits for Hawaiians.

Hence, the agreements and leases between the State and JDI indicate that the no-action alternative is not in the public interest~~has been rejected at this time~~.

2.2.1 Impact Comparison

Grading and Excavation

The proposed project requires grading and excavation. Both actions may impact groundwater due to rainfall runoff during construction. Alternative 1 would require a significantly smaller excavation for the marina basin and would therefore carry a lesser risk of potential adverse effects on water quality. Alternative 2 would require the same basin excavation as the proposed project, and would also include extensive grading and filling to build the golf course, the latter of which would generate additional impacts. Alternative 3 would result in no change to the geography, topography and geology.

Further discussion on grading and excavation is contained in Section 3.3.

Natural Drainage

Most precipitation infiltrates into the porous ground at the site, and no significant sheet flow is likely. Alternative 1 would generate similar levels of impacts on natural drainage as those of the proposed project and thus require similar mitigation measures. The golf course in Alternative 2 would not be as porous since the site would be graded, soil would be placed, and grass and other landscaping would be grown. Sheet flow and runoff can occur on a golf course, and drainage patterns might change. Alternative 3 would result in no change to the existing natural drainage pattern. Further discussion on natural drainage is contained in Section 3.4.

Air Quality

Air quality will be affected by construction activities, as well as pollutants from vehicular, industrial, natural, and agricultural sources. Alternative 1 would generate less construction air quality impacts than the proposed project due to the reduced amount of intensive groundwork associated with the smaller marina basin and fewer long-term impacts by reducing traffic 35 and 40 percent during, respectively, AM and PM peak traffic times. Construction of Alternative 2 would result in fugitive dust and exhaust from equipment and is expected to generate the same level of air quality impact as the proposed project. Alternative 3 would result in no change to existing air quality. Further discussion on air quality is contained in Section 3.5.

Terrestrial Environment

To provide additional habitat for shorebirds and some visiting seabirds, the project proposes to construct a brackishwater pond area suitable for avian fauna, including stilts, coots and ducks. While habitat expansion is beneficial, there is also a possibility that these species may be exposed to activity that may harm them. Alternative 1 would not include a brackish water pond, but will include 5 acres of seawater features, which is 74 percent less than the 19 acres of seawater features in the proposed project. While this would reduce beneficial impacts, it would also decrease exposure to potentially harmful activity. Alternative 2 does not include the brackish water pond features, but would include drainage retention basins that would attract avian fauna and expose them to chemicals used to maintain golf course landscaping. While Alternative 3 would result in no increase in potentially harmful activity, it would also not provide additional habitat for avian fauna. Further discussion on the terrestrial environment is contained in Section 3.7.

Groundwater

Groundwater at the project site occurs as a thin basal brackish water lens. It is influenced by tides and varies in flow direction and salt content. The existing Honokōhau Harbor acts as a drainage point for local groundwater. Any impact to groundwater flow from the proposed harbor is likely to be localized. The proposed marina basin will not result in any significant increase in groundwater flow to the coastline, but rather a concentration and redirection of the existing flows to the harbor entrance.

There will be differences in the flow to the marina entrance between the proposed project and Alternative 1. Alternative 1, being smaller in size, will have less impact on groundwater flow than the proposed marina. Alternative 2 will have a similar impact to groundwater quality as the proposed project. Alternative 2 may also impact water quality by contributing nutrients and biocides to the groundwater from the golf course. Alternative 3 would result in no change in existing groundwater conditions. Further discussion on groundwater is contained in Section 3.8.1.

Surface Water

There are no significant natural freshwater streams or ponds at the site, but there are brackish anchialine pools. Surface water at the project site will be influenced by rainfall. Runoff typically percolates rapidly through the permeable ground. The proposed project will include some impermeable surfaces, which together with building roofs, will change runoff and seepage patterns.

Alternative 1 is a lower density project that is expected to have proportionally less impact on surface water and runoff patterns and less potential impact on water quality than the proposed project. Alternative 2 would have more impact on surface water quality than the proposed project due to fertilizers and biocides carried by runoff from the golf course. Alternative 3 would result in no change to surface water conditions. Further discussion on surface water is contained in Section 3.8.2.

Nearshore Environment and Coastal Waters

The potential adverse impacts to the marine environment from the proposed project are due to the construction of an 800-slip marina and the resulting inflow of higher salinity seawater and inadequate water circulation, both of which are anticipated to impair water quality to the extent of falling below applicable standards. One possible mitigation measure is to significantly reduce the size of the marina expansion.

The reduced marina size (from 45 to 25 acres) and reduced lagoon acreage in Alternative 1 are expected to result in a proportionate reduction in seawater discharging into the new harbor and increased water circulation. Alternative 2 includes the same marina basin size and is therefore subject to the same factors that are expected to adversely affect water quality.

In the existing Honokōhau Harbor, water quality issues focus on the potential for pollutants, sediments, mixing and discharge into the nearshore marine waters. Before the harbor was constructed, any pollutants entrained within the groundwater were believed to have been diffused over a broad coastline.

The water quality in the proposed harbor depends on several components. These include salinity, nutrients, and sediments that come from the ocean, rainfall runoff, water features with marine animals, and dust. The smaller project offered as Alternative 1 is expected to produce a reduced amount of pollutants and reduce the risk of adverse impact upon water quality.

It is notable that the 45-acre marina basin planned in the proposed project and Alternative 2 only becomes viable from a water quality impact standpoint if the additional brackish groundwater inflow into the new marina exceeds 60 mgd. The resulting flushing from such inflow would be expected to better maintain water quality. However, it is unclear whether 60 mgd of brackish groundwater would be available. As proposed in Alternative 1, reduction of the volume of the new marina basin by 45 percent will significantly improve the flushing and water quality because the lower volume can be flushed by the available groundwater flow.

In addition, there could be higher rainfall runoff from the Alternative 2 golf course into the harbor, because the grassed golf course will be less porous than the natural surface. The golf course will also require relatively high levels of fertilizer, biocides, and irrigation, all of which could contribute to adverse water quality impacts.

Further discussion on nearshore environment and coastal waters is contained in Section 3.9.1.

Anchialine Pools

Anchialine pools are located north of Honokōhau Harbor, and south of the harbor on the project site. The marine life in these pools is sensitive to groundwater quality, and changes due to construction and operation of the project could degrade the viability of the pool ecosystem. In the southern complex, 3 anchialine pools with a combined surface area of $20m^2$ would be eliminated due to the harbor construction in the proposed project and Alternatives 1 and 2.

Predicting the extent of change in groundwater flow is difficult if not impossible even with numerous boreholes and intense sampling. The actual flow of groundwater towards the sea is minimal today, and tidal measurements show that tide fluctuations represent more than 90 percent in actual harbor tides. The fluctuations occur simultaneous with the ocean/harbor tide, which indicate a vertical and horizontal pressure regime between bore hole 6 and the ocean and harbor. Hence, the tides alone create a mixing system that increases salinity, as the flow approaches the point of discharge which will be either the channel or the shore. Another factor that could influence groundwater quality is the increased local recharge from irrigation between the channel and shore. This will add fresh water to the lens locally but is not quantified at this time.

Quantification of these impacts, including the flow of groundwater through each pond, is therefore extremely difficult. The shallow lavas are of the pahoehoe type and have a relatively high horizontal permeability. In surface depressions or undulations, the pahoehoe lavas have a tendency to lose vertical permeability from sedimentation thus restricting water exchange within the individual pools. This is normally reflected in both the salinity and temperature and this information has been adequately studied in the pools.

Changes in groundwater quality may or may not impact biological communities in the anchialine and estuarine environment. In either case, it is important to understand these relationships to effectively manage the resource. If there is significant deviation from the baseline especially in regard to nutrients, pathogens, and toxins, a mitigation plan to determine the cause and take decisive appropriate action will be implemented.

Due to the uncertainty of changes in groundwater flow and quality due to marina construction, the variability in impacts between the proposed project and Alternatives 1 and 2 is unknown at this time. Alternative 3 would result in no change in groundwater flow. While this would eliminate the potential for adverse impacts, Alternative 3 would also continue the pattern of existing degradation related to human activity and the introduction of alien species. Further discussion on anchialine pools is contained in Section 3.9.2.

Marine Fishing Impacts

The proposed marina will increase the number of boats in the area and it is reasonable to assume that a portion of these new boats will engage in fishing activities. The increase in boats in the area would be primarily related to the marlin and tuna / pelagic fishery, coral reefs due to extractive fisheries, and SCUBA activities. The pressure on fish and invertebrate stocks is expected to increase with or without the marina. Harbor expansion provides the opportunity to address existing conditions to consolidate, focus, and fund management and enforcement activities at one location.

Compared to the proposed project, Alternative 1 would result in a 21 percent decrease in boat traffic, thereby lessening the potential for marine fishing impacts. The level of impacts in Alternative 2 would be similar to that of the proposed project. Alternative 3 would result in no change in existing marine fishing conditions, and no opportunity to address already existing pressure on fish and invertebrate stocks. Further discussion on marine fishing impacts is contained in Section 3.9.3.

Cultural and Archaeological Resources

The proposed project will integrate cultural and archaeological resources in the overall development. Archaeological sites recommended for preservation will be preserved, and cultural practices will be encouraged. Kona Kai Ola includes a canoe park, and a cultural park with a focus on Hawaiian maritime cultural heritage of the voyaging canoe. Proposed is a 400-foot shoreline setback that would serve as a buffer between the ocean and developed areas. This coastal area would be protected with a shoreline park with trails and public access parking for walking and shoreline fishing, and a cultural park surrounding the heiau, the cultural sites and 'Alula for community use.

Alternative 1 would contain all of the cultural archaeological features and the shoreline setback area would be 400 feet in the northern portion of the site and increase to 600 feet in the southern portion. Alternative 2 would preserve cultural and archaeological resources, but does not include a 400-foot shoreline setback. Alternative 3 would result in no change to existing cultural and archaeological resources and no addition of cultural and community facilities and activities. Further discussion on cultural and archaeological resources is contained in, respectively, Sections 4.1 and 4.2.

Noise

Project-generated noise is due to construction equipment and blasting, boats, marina activities, vehicle traffic, and the Kealakehe Wastewater Treatment Plant operations. Alternative 1 would generate less noise impacts due to reduced construction activities, fewer boats, less traffic and less on-site activity. Alternative 2 would also generate less noise due to reduced traffic and less on-site activity, but noise related to the excavation of the marina basin and an increase in the number of boats would be similar to that of the proposed project. Further discussion on noise impacts is presented in Section 4.4.

Socioeconomic Impacts

The proposed project will generate an increase in de facto population of an estimated 5,321 persons due to the increase in hotel and time-share units. The estimated de facto population increase in Alternative 1 is 37 percent less, at 3,363 persons, than the proposed project. The de facto population increase in Alternative 2 is similar to Alternative 1.

Employment in the commercial components will nearly double in Alternative 1, from a stabilized level of 1,429 full-time equivalent (FTE) positions in the proposed project to 2,740 in the Alternative 1.

Under Alternative 1, the total operating economic activity at Kona Kai Ola will increase due to the added commercial space more than off-setting the fewer visitor units, moving upward from $557.6 million per year to circa $814.3 million annually. The total base economic impact resulting from development and operation of Alternative 1 will similarly be higher by between 35 and 45 percent than that of the proposed project.

Alternative 1, which has a reduced marina size of 25 acres, and fewer hotel and time-share units, would have a meaningful market standing, create significant economic opportunities, and provide a net benefit to State and County revenues. From a market perspective, a smaller Kona Kai Ola would still be the only mixed use community in the Keahole to Kailua-Kona Corridor offering competitive hotel and time-share product.

The estimated absorption periods for marketable components of Alternative 1 are generally shorter than those for the same components in the proposed project. Marina slips under Alternative 1 are estimated to be absorbed within 2 years after groundbreaking, as compared with 9 years for absorption of slips in the proposed project. Hotel rooms under Alternative 1 are estimated to be absorbed within 4 years after groundbreaking, as compared with 7 years under the proposed project. Time-share units would be absorbed within 10 years under Alternative 1, while 15 years are projected under the proposed project. Due to the planned increase in commercial facilities under Alternative 1, the absorption period of commercial space is estimated at 14 years, as compared with 8 years for absorption of such facilities under the proposed project.

The State and County will still both receive a net benefit (tax receipts relative to public expenditures) annually on a stabilized basis under the Alternative 1. The County net benefits will be some $12.2 million per year under the Alternative 1 versus $14.9 million under the proposed project. The State net benefits will increase under the Alternative 1 to about $37.5 million annually, up substantially from the $11.4 million in the proposed project.

Due to the lower de facto population at build-out, the effective stabilized public costs for both the State and County will decline meaningfully under the Alternative 1, dropping from $7.7 million annually for the County and $36.5 million for the State, to $4.9 million and $23 million per year, respectively.

Alternative 3 would result in no increase in de facto population and improvement to economic conditions. Further discussion on social and economic impacts are contained in, respectively, Sections 4.5 and 4.6.

Vehicular Traffic

The proposed project will impact the nearby road network that currently is congested during peak traffic times. The proposed project includes roadway improvements that would reduce the impact and improve roadway conditions for the regional community.

Alternative 1 includes the same roadway system improvements as the proposed project, yet would reduce vehicular traffic by 35 percent when compared to the proposed project. Alternative 2 would have similar traffic conditions and roadway improvements as Alternative 1. Alternative 3 would result in no increase in traffic and no roadway improvements.

Marina Traffic Study

The increase in boat traffic due to the proposed 800-slip marina would cause entrance channel congestion during varying combinations of existing and new marina peak traffic flow. Worst case conditions of active sport fishing weekend and summer holiday recreational traffic result in traffic volumes exceeding capacity over a short afternoon period. Mitigation to address boat traffic in the proposed project include widening the entrance channel, traffic control, implementation of a permanent traffic control tower, or limiting vessel size.

Alternative 1 would result in a 21 percent reduction in boat traffic congestion under average existing conditions and ten percent reduction during peak existing conditions. The reduction to 400 slips also reduces the impacts of congestion at the entrance channel, thereby reducing the need for any modifications to the entrance channel.

Alternative 2 would have the same level of boat traffic as the proposed project. Alternative 3 would not meet the demand for additional boat slips and would not generate additional boat traffic. Further discussion on marina traffic is contained in Section 4.8.

Police, Fire and Medical Services

The proposed project will impact police, fire and medical services due to an increase in de facto population and increased on-site activity. Alternatives 1 and 2 would have similar levels of impact as the proposed project due to increased on-site activity. Further discussion on police, fire and medical services are contained, respectively, in Sections 4.10.1, 4.10.2 and 4.10.3.

Drainage and Storm Water Facilities

The proposed project will increase drainage flows, quantities, velocities, erosion, and sediment runoff.

Alternative 1 involves a reduction of the project density that would reduce storm runoff from the various land uses due to a reduction in impervious surfaces associated with hotel and time-share development and to the creation of more open space. However, roadway areas will increase by about 30 percent in Alternative 1. Storm runoff from proposed streets would therefore increase; thus requiring additional drainage facilities and possibly resulting in no net savings. The golf course in Alternative 2 may also change drainage characteristics from those of the proposed project and may not reduce impacts. Alternative 3 would result in no change in existing conditions and no improvements to drainage infrastructure. Further discussion on drainage and storm water facilities is contained in Section 4.10.5

Wastewater Facilities

The proposed development is located within the service area of the Kealakehe WWTP and a sewer system will be installed that connects to the WWTP. The sewer system will be comprised of a network of gravity sewers, force mains, and pumping stations which collect and convey wastewater to the existing Kealakehe WWTP. Project improvements will incorporate the usage of recycled / R1 water. Improvements implemented by the proposed project will also accommodate the needs of the regional service population.

Alternative 1 would generate approximately 10 percent less wastewater flow than the proposed project. Wastewater flow in Alternative 2 is undetermined. Alternative 3 would result in no additional flow, as well as no improvements that will benefit the regional community. Further discussion on wastewater facilities is contained in Section 4.10.6.

Potable Water Facilities

The proposed project average daily water demand is estimated at 1.76 million gallons per day. Existing County sources are not adequate to meet this demand and source development is required. The developer is working with DLNR and two wells have been identified that will produce a sustainable yield that will serve the project. These wells will also serve water needs beyond the project.

Alternative 1 would result in net decrease of about five percent of potable water demand. Alternative 2 may have a lower water demand than the proposed project as long as potable water is not used for irrigation. Alternative 3 would result in no additional flow, as well as no source development that will benefit the regional community. Further discussion on potable water facilities is contained in Section 4.10.8.

Energy and Communications

Regarding Alternative 1, preliminary estimates for electrical, telecommunications, and cable resulted in a net demand load that remains similar to the proposed project. Further discussion on energy and communications is contained in Section 4.10.9.1.

The proposed project will increase the demand for electrical energy and telecommunications. The demand would be reduced in Alternative 1 because the number of boat slips and units would decrease. Similarly, Alternative 2 would have fewer units than the proposed project and therefore reduce energy demands. Further reduction in energy demand for either alternative could be achieved by using seawater air conditioning (SWAC) and other energy reduction measures, as planned by the developer. Further discussion on energy and telecommunications is contained in Section 4.10.9.2.

Water Features and Lagoons

The proposed project includes a brackishwater pond, lagoons, and marine life exhibits supplied by clean seawater. The water features in Alternative 1 would significantly decrease by 74 percent from 19 acres in the proposed project to five acres in Alternative 1. This decrease in water features would result in a corresponding decrease in water source requirements and seawater discharge. Alternative 2 does not include the seawater features. Alternative 3 would result in no additional demand for water source requirements and seawater discharge.

2.2.2 Conformance with Public Plans and Policies

State of Hawai‘i

Chapter 343, Hawai‘i Revised Statutes

Compliance with this chapter is effected, as described in Section 5.1.1 in regard to the proposed project and the alternatives discussed.

- State Land Use Law, Chapter 205, Hawai‘i Revised Statutes

  The discussion in Section 5.1.2 is directly applicable to Alternative 1, the proposed project. Alternative 1 will involve a setback of 400 feet that increases to 600 feet along the southern portion of the project site’s shoreline area. Alternative 2 does not provide for such a setback, but may still require approvals from DLNR for cultural, recreational, and community uses and structures within the Conservation district.

- Coastal Zone Management Program, Chapter 205A, Hawai‘i Revised Statutes

  Recreational Resources:

  In addition to the discussion of consistency with the associated objective and policies, as described in Section 5.1.3, the reduction from the proposed project’s 800-slip marina to a 400-slip marina under Alternative 1 will still expand the region’s boating opportunities and support facilities. The existing harbor entrance will still be utilized under this alternative; however, potential risks relating to boat traffic and congestion in the marina entrance area will be reduced significantly. The 400-600 foot shoreline setback, public parks, trails, cultural areas, community facilities, and marine science center remain important recreational components under Alternative 1.

Alternative 2 includes a golf course component, which would add a more passive recreation to the active and social components, such as boating, fishing, swimming, trails, walkways, parks, marine life, educational and interactive areas that are also part of the project. The golf course would enhance the range of leisure and recreational opportunities offered at Kona Kai Ola.

Alternative 2, like the proposed project, will expand the region's boating opportunities and support facilities through its 800-slip marina. However, the potential adverse impacts of increased boat traffic from the size of the marina are significant enough to offset the benefits of increased boating opportunities.

Coastal Ecosystems:

The discussion in Section 5.1.3 is directly applicable to Alternative 1.

Alternative 1 not only reduces the number of slips proposed by 50 percent, but it also reduces the size of the marina from 45 acres to 25 acres. The 25-acre marina will increase the body of water within the existing harbor, but to a significantly lesser extent than the proposed project's estimated increase, which is also applicable to the 45-acre size that is proposed for the marina under Alternative 2.

The findings of the Harbor Water Quality Modeling Study conclude that a reduction in the size of the harbor expansion is an alternative that will mitigate the risk of significant impacts upon water quality within the marina and existing harbor. Accordingly, the reduction in both the number of slips and the size of the marina basin under Alternative 1, in combination with proper facilities design, public education, and enforcement of harbor rules and regulations, would result in fewer long-term impacts to water quality and coastal ecosystems. Short-term (construction-related) impacts would likely remain the same although the reduction in the total acreage of excavation is expected to result in a shorter duration of such impacts.

In addition to its 800-slip marina and potential adverse impacts upon water quality and the marine environment, Alternative 2 includes a golf course component, which has the potential to impact coastal ecosystems by increasing the nutrient loading in surface runoff and groundwater and also by introducing pesticides, herbicides, and other chemicals common in golf course use and management into the nearshore waters surrounding the project site.

Economic Uses

Although reduced in the number of slips, the smaller marina under Alternative 1 will nevertheless serve public demand for more boating facilities in West Hawai‘i and is consistent with the objective and policies and discussion set forth in Section 5.1.3. The economic impacts of Alternative 2, while comparable to those of the proposed project's marina development, are notably marginal as to the golf course component, based on the marketability analysis that indicates a condition of saturation within the region.

Coastal Hazards

The discussion and considerations set forth in Section 5.1.3 are also applicable to Alternatives 1 and 2 and indicate compliance with the objective and policies addressed. Tsunami risks mainly affect the large shoreline setback area that is proposed for the project and Alternative 1. Alternative 2 projects a transient accommodation site that is partially within the tsunami hazard zone and thus carries a higher hazard risk. However, the essential requirement for these alternatives, as well as the proposed project, is a well-prepared and properly implemented evacuation plan.

Beach Protection

Discussion and considerations set forth in Section 5.1.3 are also applicable to Alternatives 1 and 2 and indicate compliance with the objective and policies addressed. Alternative 1 and, to a lesser extent, Alternative 2, will retain the shoreline area in its natural condition.

Similar to the proposed project, Alternative 1 provides for a shoreline setback of considerable width within which no structure, except for possible culturally-related structures, would be allowed. Alternatives 1 and 2 will thus be designed to avoid erosion of structures and minimize interference with natural shoreline processes.

Marine Resources

The discussion in Section 5.1.3 is also applicable to Alternative 1 which is described to be an alternative that is specifically projected to mitigate anticipated adverse impacts on water quality and the marine environment that might otherwise result from the original harbor design and scale, which is also incorporated in Alternative 2 . The reduced marina size under Alternative 1 is projected to meet water quality standards and enable greater compliance with the objective and policies addressed in this section.

Alternative 2 includes a golf course component and thus the potential to adversely impact marine resources by increasing the nutrient loading in surface runoff and groundwater and also by introducing pesticides, herbicides, and other chemicals common in golf course use and management into the nearshore waters surrounding the project site.

Hawai‘i State Plans, Chapter 226, Hawai‘i Revised Statutes

Section 226-4 (State goals), 5 (Objectives and policies for population, and 6 (Objective and policies for economy in general):

The discussion in Section 5.1.4 is applicable to Alternatives 1 and 2, in addition to the proposed project. These development concepts generally conform to the goals, objectives, and policies set forth in these sections because they will provide some degree of economic viability, stability, and sustainability for future generations. Kona Kai Ola will convert essentially vacant land into a mixed-use development with a distinctive marina and boating element, providing a wide range of recreational, business, and employment opportunities to the community.

Section 226-8 Objective and policies for the economy – the visitor industry:

Alternatives 1 and 2 will be consistent with the State's economic objective and policies relating to the tourism industry for the same reasons that are discussed in regard to the proposed project in Section 5.1.4. They will incorporate JDI's commitment to sustainability principles in the planning and design of the development concepts in Alternatives 1 and 2. Although the total hotel and time-share unit count is reduced to approximately 1,500 in Alternatives 1 and 2, the transient accommodations component of these alternatives will still further the State's objective and policies for increased visitor industry employment opportunities and training, foster better visitor understanding of Hawai‘i's cultural values, and contribute to the synergism of this mixed-use project concept that addresses the needs of the neighboring community, as well as the visitor industry.

Section 226-11 Objectives and policies for the physical environment: land-based, shoreline and marine resources:

Alternative 1 is expected to involve less potential adverse impacts upon these environmental resources than the proposed project. Likewise, and Alternative 2 would have less adverse impact because of its reduction in the size of the marina and in the total hotel and time-share unit count. Alternative 1 carries less potential risk to water quality and related impacts upon the marine environment and anchialine pool ecosystems. Although approximately three anchialine pools are expected to be destroyed, the great majority of pools will be preserved within and outside of the proposed 400-foot shoreline setback.

The golf course component in Alternative 2 has the potential to impact marine resources by increasing the nutrient loading in surface runoff and groundwater and also by introducing pesticides, herbicides, and other chemicals common in golf course use and management into the marina basin and nearshore waters surrounding the project site. It also has the potential to adversely affect the anchialine pools by introducing the chemicals into the pond systems.

Section 226-12 Objective and policies for the physical environment: scenic, natural beauty, and historic resources:

The discussion in Section 5.1.4 is directly applicable to Alternative 1 and describes the compliance with the objective and policies addressed.

The golf course component of Alternative 2 would create a park-like view that would potentially enhance the beauty of the project site and surrounding areas when considered in combination with the existing rugged natural beauty of the area.

Just as with the proposed project, Alternatives 1 and 2 would also be designed to blend with the natural terrain and to honor and protect the cultural history, resources, and practices of these lands.

Section 226-13 Objectives and policies for the physical environment: land, air and water quality:

As stated above, because of the reduction in both the number of slips and the size of the marina basin, with proper facilities design, public education and enforcement of harbor rules and regulations, Alternative 1 is anticipated to cause fewer long-term impacts to water quality than either the proposed project or Alternative 2. Based on the findings of the Harbor Water Quality Modeling Study, water quality resulting from a reduced marina basin size as proposed under Alternative 1 is expected to be similar to existing conditions.

As previously noted, Alternative 2 has the potential to adversely impact water quality by increasing the nutrient loading in surface runoff and groundwater by introducing pesticides, herbicides and other chemicals common in golf course development and maintenance into the marina basin and nearshore waters surrounding the project site.

Section 226-14 Objectives and policies for facility systems - general:

Alternatives 1 and 2 will conform to the objective and policies of this section on the grounds that are discussed in regard to the proposed project in Section 5.1.4. The master-planning and phasing of the project concepts under these alternatives will be coordinated with associated public and private infrastructural planning and related private and public infrastructural financing. The cost of the marina construction and project-related infrastructure is to be borne by the developer, resulting in considerable savings for the public. In addition, the projected lease revenue from these public lands will provide additional public benefits by establishing a revenue stream for capital improvements and maintenance of a range of State facilities.

Section 226-15 Objectives and policies for facility systems - solid and liquid wastes:

In addition to the developer's commitment to sustainable development design, the project will involve upgrades to the County of Hawaiʻi's Kealakehe Wastewater Treatment Plant to meet current needs, as well as the project's future needs. This commitment is applicable to Alternatives 1 and 2, as well as the proposed project that is discussed in Section 5.1.4.

Section 226-16 Objectives and policies for facility systems – water:

The discussion of water conservation methods and the need to secure additional potable water sources in Section 5.1.4 is also applicable to Alternative 1 and demonstrates conformity to the objective and policies for water facilities. Alternative 2 involves greater irrigation demands in regard to its golf course component and greater potable water demands for human consumption than those for Alternative 1. Alternative 2 is expected to face more serious challenges in securing adequate and reliable sources of water.

Section 229-17 Objectives and policies for facility systems – transportation:

Alternatives 1 and 2 will conform to this objective and policies because they will present water transportation opportunities, including the possible use of transit water shuttles to Kailua-Kona, as described in regard to the proposed project in Section 5.1.4.

Section 226-18 Objectives and policies for facility systems – energy:

Alternatives 1 and 2 conform to these objective and policies through the use of energy efficient design and technology and commitment to the use and production of renewable energy to serve the project's needs. Solar energy production, solar hot water heating, and the use of deep cold seawater for cooling systems are currently identified as means of saving substantial electrical energy costs for the community and the developer.

Section 226-23 Objectives and policies for socio-cultural advancement – leisure:

Alternative 1 conforms to this objective and related policies for the reasons offered in Section 5.1.4 in regard to the proposed project. Alternative 1 will be of greater conformity with the policy regarding access to significant natural and cultural resources in light of the 400-600 foot shoreline setback that has been designed for this alternative.

Although it does not propose the considerable shoreline setback that is planned for Alternative 1, Alternative 2 is consistent with this objective and related policies in incorporating opportunities for shoreline-oriented activities, such as the walking trails. In addition, the golf course component adds a more passive recreation alternative to the active and social components, such as boating, fishing, swimming, trails, walkways, parks, marine life educational and interactive areas that are also part of the project. The golf course would enhance the range of leisure and recreational opportunities offered at Kona Kai Ola.

Section 226-25 Objectives and policies for socio-cultural advancement-culture:

The discussion in Section 5.1.4 is relevant to Alternatives 1 and 2 and demonstrate their conformity the objective and policies of this section.

Both alternatives involve the preservation and protection of cultural features that have been identified by the Cultural Impact Assessment and archaeological studies for the project area. Both provide for public shoreline access, and both will continue the policy of close consultation with the local Hawaiian community and cultural and lineal descendants in the planning of cultural resource preservation and protection.

Section 226-103 Economic priority guidelines:

Alternatives 1 and 2 conform to these guidelines for the same reasons that are set forth in Section 5.1.4. They involve private investment in a public project that will create economic diversification through a mix of marina, industrial, commercial, visitor, and cultural facilities. This presents a wide range of entrepreneurial opportunities, long-term employment opportunities, and job training opportunities.

Section 226-104 Population growth and land resources priority guidelines:

As described in Section 5.1.4, the policy support for the proposed project also extends to the similar development concepts considered in Alternatives 1 and 2. Those alternatives conform to the guidelines of this section because they involve an urban development under parameters and within geographical bounds that are supported by the County's General Plan, a preliminary form of the Kona Community Development Plan, the County's Keahole to Kailua Regional Development Plan, and the reality of being located along the primary commercial/industrial corridor between Keahole Airport and Kailua-Kona. As with the proposed project, the development concepts of Alternatives 1 and 2 are essentially alternatives for the implementation and "in-filling" of the urban expansion area in North Kona.

DHHL Hawai'i Island Plan

This 2002 plan projects DHHL's Honokōhau makai lands for commercial use. As compared to the proposed project and Alternative 2, Alternative 1 presents an expanded commercial component that provides greater compliance with the plan, while addressing certain beneficiaries' concerns about the scale of the marina originally required in the Project. Alternative 2 also conforms to the recommended commercial uses in the makai lands but to a lesser degree than Alternative 1 because of its more limited commercial component. Like the proposed project, its marina size and number of slips raise environmental issues, as more specifically discussed in Part 3, and community concerns.

County of Hawai'i General Plan

HCGP Section 4 – Environmental Quality Goals, Policies and Courses of Action:

Alternative 1 is consistent with this section. It presents a reduction in both the number of slips and the size of the marina basin that, in combination with proper facilities design, public education and enforcement of harbor rules and regulations, would result in very few long term impacts to water quality. Based on the findings of the Harbor Water Quality Modeling Study, water quality would remain similar to existing conditions.

Alternative 2 is the least consistent with this section. In addition to the potential significant impacts of its 800 slip marina basin, its golf course component has the potential to adversely impact marine resources by increasing the nutrient loading in surface runoff and groundwater and also by introducing pesticides, herbicides and other chemicals common in golf course use and management into the nearshore waters surrounding the project site. It also has the potential to adversely affect the anchialine pools beyond their current conditions by introducing such substances into the pool systems.

HCGP Section 7 – Natural Beauty Goals and Policies:

Alternative 2 conforms to some degree with this section. Its golf course component would create a park-like view that would potentially enhance the beauty of the project site and surrounding areas when considered in combination with the existing rugged natural beauty of the area, as demonstrated in other makai golf courses within the region.

HCGP Section 8 – Natural Resources and Shoreline:

Alternative 1 is most consistent with the goals and policies of this section. It would require considerably less marina excavation than the proposed project and Alternative 2 and would reduce the potential risk of long-term adverse impacts to water quality. Based on the findings of the Harbor Water Quality Modeling Study, water quality would remain similar to existing conditions with the degree of reduction in marina basin size that is proposed under Alternative 1. This reduction is also expected to reduce potential impacts upon anchialine pools and their ecosytems, as well as shoreline and marine resources that are affected by water quality. Alternative 1 also retains the shoreline preservation and protection concepts that are proposed in and described for the Project.

HCGP Section 10 – Public Facilities Goals and Policies:

The discussion in Section 5.2.1. in relation to the proposed project is applicable to Alternatives 1 and 2. Improvements to public facilities are are integral to the Kona Kai Ola development. The provision of additional boat slips and numerous road improvements, including a makai extension of Kuakini Highway south to Kailua-Kona are incorporated into plans for the project’s development. In light of these elements, Alternatives 1 and 2 are consistent with the goals and policies of this section.

HCGP Section 11 – Public Utility Goals, Policies:

As with the proposed project, Alternatives 1 and 2 are consistent with the goals and policies of this section, based on the relevant grounds set forth in Section 5.2.1. The developer is committed to design, fund, and develop environmentally sensitive and energy efficient utility systems to the extent possible, as described previously in Part 5. Its master planning provides for the coordinated development of such systems with the objective of achieving significant savings for the public. As previously-mentioned example, the project development involves the upgrading of the Kealakehe Wastewater Treatment Plant.

HCGP Section 12 – Recreation:

Alternative 1 is consistent with the goals, policies, and courses of action for North Kona in this section.

Although the number of slips is reduced under Alternative 1, the region's boating opportunities and support facilities will still be expanded. The existing marina entrance would still be utilized under this alternative. However, concerns relating to increased activity leading to increased congestion in the marina entrance area would be mitigated to a certain extent. The 400-600 foot shoreline setback, public parks, trails, cultural areas, community facilities and marine science center remain important components of Alternative 1.

The golf course component of Alternative 2 would add a more passive recreation to the active and social components, such as boating, fishing, swimming, trails, walkways, parks, marine life, educational and interactive areas that are also part of the project. The golf course would enhance the range of leisure and recreational opportunities offered at Kona Kai Ola. Alternative 2 is also considered to be consistent with this section.

HCGP Section 13 and 13.2 – Transportation:

The reduced marina component under Alternative 1 will still provide transportation opportunities and provide for possible use of transit water shuttles to Kailua-Kona, although to a lesser degree than under the proposed project and Alternative 2 . However, in each scenario, internal people-movers are planned, and numerous roadway improvements are planned for coordination with public agencies, including but not limited to the construction of the Kuakini Highway extension between Honokōhau and Kailua-Kona. Accordingly, both Alternatives 1 and 2 are consistent with the goals, policies, and courses of action for North Kona under these sections of the General Plan.

HCGP Section 14.3 – Commercial Development:

For the reasons presented in the discussion under Section 226-104 of the State Plan, the planned commercial component under Alternatives 1 and 2 are consistent with this section.

HCGP Section 14.8 – Open Space:

Alternatives 1 and 2 are consistent with the goals and policies of this section. Alternative 1 provides a considerable (400-600 foot) shoreline setback along the entire ocean frontage of the project site as a means of protecting the area's scenic and open space resources, as well as natural and cultural resources. Although it does not incorporate the shoreline setback planned in Alternative 1, Alternative 2 provides a golf course component would contribute to the amount of open space that is currently proposed and allow additional view corridors to be created.

Community Development Plans

Community development plans are being formulated for different regions in the County in order to supplement the County's General Plan. The Kona Kai Ola project is located in the Kona Community Development Plan (CDP) area. Maps associated with the preliminary work phases

of the Kona CDP include the Kona Kai Ola project site within the “Preferred Urban Growth” boundary of the North Kona district. The Kona CDP process is guided by a Steering Committee composed of a broad cross-section of the community. The Steering Committee will eventually complete its work and recommend the CDP’s adoption.

After the DEIS was published, the Kona CDP has progressed to the development of plans for the major urban growth corridor north of Kailua-Kona. The Kona CDP has produced a draft plan showing a transit oriented development that includes a midlevel public transit corridor along the mauka residential elevation, and a makai transit corridor that runs along a proposed new frontage road just makai and parallel to Queen Kaahumanu Highway. The development plan for Alternative 1 includes the Kuakini Highway as part of this proposed frontage road and transit line from Kailua Kona to the Kealakehe area, along with a transit stop at Kona Kai Ola. The Alternative 1 plan also includes a road that could be extended to be part of the proposed frontage road should it be approved and implemented. In addition, the Kona CDP has continued to emphasize the principles of smart growth planning with mixed use urban areas where people can live, work, play and learn in the same region. Kona Kai Ola has been specifically designed to be consistent with this policy in order to provide a stable employment base close to where people live in the mauka residential areas already planned for DHHL and HHFDC lands.

It should be noted that currently and over the years, the 1990 Keāhole to Kailua Development Plan (K-to-K Plan) guides land use actions by the public and private sectors. It is intended to carry out the General Plan goals and policies related to the development of the portion of North Kona area, including the Kona Kai Ola site. The “Preferred Growth Plan” of the Keāhole to Kailua Development Plan identifies the project site as a new regional urban center to include commercial, civic, and financial business related uses, an expanded “Harbor Complex,” a shoreline road, and a shoreline park. The proposed project and the development concepts in Alternatives 1 and 2 are therefore consistent with the recommendations in the Keāhole to Kailua Development Plan.

Hawai‘i County Zoning

As shown on Figure AA, the project site is zoned “Open”. Under Section 25-5-160 of the Hawai‘i County Code, “The O (Open) district applies to areas that contribute to the general welfare, the full enjoyment, or the economic well-being of open land type use which has been established, or is proposed. The object of this district is to encourage development around it such as a golf course and park, and to protect investments which have been or shall be made in reliance upon the retention of such open type use, to buffer an otherwise incompatible land use or district, to preserve a valuable scenic vista or an area of special historical significance, or to protect and preserve submerged land, fishing ponds, and lakes (natural or artificial tide lands)”.

Some of the proposed uses at Kona Kai Ola are permitted uses in the Open zone such as:

- Heiau, historical areas, structures, and monuments;
- Natural features, phenomena, and vistas as tourist attractions;
- Private recreational uses involving no aboveground structure except dressing rooms and comfort stations;

- Public parks;
- Public uses and structures, as permitted under Section 25-4-11.

In addition to those uses permitted outright, the following uses are permitted after issuance of a use permit:

- Yacht harbors and boating facilities; provided that the use, in its entirety, is compatible with the stated purpose of the O district.
- Uses considered directly accessory to the uses permitted in this section shall also be permitted in the O district.

The proposed time-share and hotel units and commercial uses would not be consistent with the zoning designation of “Open”. Project implementation therefore requires rezoning of portions of the project to the appropriate zoning category or use permits for certain uses.

Special Management Area

As shown in Figure AB, the entire project area up to the highway is within the coastal zone management zone known as the Special Management Area (“SMA”). At the County level, implementation of the CZM Program is through the review and administering of the SMA permit regulations. Kona Kai Ola complies with and implements the objectives and policies of the Coastal Zone Management (CZM) Program, and a full discussion is provided in Section 5.1.3. The development concepts in the proposed project and Alternatives 1 and 2 will be subject to applicable SMA rules and regulations.

Attachment 2

3.9.1 Nearshore Environment and Coastal Waters

3.9.1.1 Existing Conditions

Along the Kona Coast the nature of the benthic community is largely a function of depth and wave action. Because the island is relatively young, fringing reef structures have not yet developed and there has been no significant terra-forming through riverine processes. Coral reefs therefore develop over raw volcanic base in accordance with light availability (primarily a function of depth), wave and current action, substrate condition, and ecological interspecific competition factors.

The USGS (2007) has recently completed a benthic habitat survey of the waters off shore of the Kaloko-Honokōhau National Historical Park and fronting the Honokōhau Harbor. This study has identified 21 separate benthic habitat classes, the distribution of which is primarily controlled by the character of the submerged volcanic flows. Twelve habitat zones are identified which are controlled primarily by water depth, benthic slope, and substrate structure. The dominant structure is a large shallow bench between the shoreline and extending up to 700 meters off shore where it ends in a shallow escarpment. Coral cover is highly variable over the entire submerged park area, but some of the highest coverage is located to the north and south of the harbor channel entrance. This study identifies an area at a depth of about 10-15 meters (~40 feet) off the harbor mouth with lower than expected coral cover.

Prior to the release of the USGS study a separate effort was undertaken by Oceanic Institute to characterize the marine environment within and off shore of the Honokōhau Harbor. ~~Coral and fish communities within Honokōhau Bay and off the Kona Kai Ola site are generally typical of West Hawaiʻi reefs, with little evidence of anthropogenic impacts.~~ Quantitative transects conducted at locations north, south, and fronting the harbor concluded that ~~S~~species composition of corals was typical for Kona reefs, with Lobe coral (*Porites lobata*) and Rose-Coral (*Pocillopora meandrina*) abundant in the shallow and mid-reef zones and Finger Coral (*Porites compressa*) more abundant in deeper zones. Highest coral abundance was observed at locations immediately to the north and south of the Honokōhau Harbor entrance channel. Coral cover at locations in the Kaloko-Honokōhau National Historical Park to the north and on the other side of the point to the south of the harbor~~of these~~ were not statistically significantly different; however, reefs to the north of Honokōhau Harbor in general showed higher coral cover than reefs to the south.~~,~~ This higher density is possible ~~primarily~~ because the southern reefs are more exposed to strong surf and associated damage and scour. Coral and fish communities within Honokōhau Bay and off the Kona Kai Ola site are generally typical of West Hawaiʻi reefs, with little evidence of anthropogenic impacts.

~~Water quality conditions within Honokōhau Harbor, adjacent anchialine ponds and coastal waters of Honokōhau Bay are modified by the effects of groundwater influx. Oceanic Institute in conjunction with AECOS Laboratory of Hawaii, LLC completed water quality testing and marine biological baseline monitoring surveys as a part of this Environmental Impact Statement. These surveys were conducted to determine the existing water quality, aquatic resources and habitats within and adjacent to Honokōhau Harbor, the proposed Kona Kai Ola site, and at sites potentially impacted by the proposed development.~~

It is known and documented that freshwater intrusion into the current marina and near shore areas causes many water quality parameters to deviate from typical nearshore waters that are unaffected by large amounts of groundwater. Specific criteria established by the State Department of Health for conducting baseline water quality surveys along the Kona Coast of the Island of Hawai'i and guidelines established by the West Hawai'i Coastal Monitoring Task Force were followed in water sampling and analysis procedures (WHCMTF 1992).

Water quality testing efforts were coordinated with Waimea Water Services and Oceanic Institute to select proper sites for groundwater/springs. Water samples were collected from all significant anchialine ~~ponds~~ pools located within the project boundaries, on either side of the harbor entrance channel. ~~Pollutant~~ Water quality testing was limited to ~~ones that are reasonable to be suspected on or near the site.~~ nutrients and physical parameters known to be primary factors in pond and nearshore ecosystems function. Testing parameters were discussed with the National Historical Park Service and other stakeholder agencies. The report on Marine Water Quality and Marine Biological Baseline Studies and Impact Analysis is included in Appendix ~~G~~H-1.

Coastal waters of the site are seen as a continuous and interconnected system from the shallow low salinity groundwater flowing through the harbor, anchialine ~~ponds~~ pools, and emerging into the ocean through the harbor mouth and sub-surface springs. The less dense brackish water with its load of land-derived nutrients enters the nearshore water and spreads out as a surface layer. The degree of mixing and impacts to nearshore marine resources is determined by coastal currents, wind waves, and ocean swells.

~~Currently 3 to 4 mgd of brackish water with salinities of about 5 ppt flow through the existing harbor into the ocean. The proposed development includes marine features mauka of the proposed marina. The marine features will be supplied with up to 75 mgd of clean salt water from 100 to 300 foot depth for marine wildlife exhibits. This water will be discharged into the proposed marina and will flow back eventually into the ocean. The salinity of the discharge water from the marina will be about 34 ppt and the average discharge volume will be 79 mgd.~~

Brackish groundwater discharge input into Honokōhau Harbor was calibrated for the hydrodynamic model using salinity profiles (OI Consultants, 1991 and Glenn, 2006) and the Harbor flushing time (OI Consultants, 1991). This calibration and analysis is described in Appendix U. The calibration period was selected to coincide with the flushing study conducted in 1991. Both OI Consultants (1991) and Glenn (2006) showed salinity profiles that did not go below about 25 ppt at the back of the harbor and the contours are well defined and mainly confined within the top 2-3 feet of the harbor. This indicates that the brackish groundwater entering the system is likely to be in the range of 20 ppt (indicated by the maintained stratification or low mixing and mid-20 ppt contours near the wall). Ziemann (2006) noted in his observations that it appeared that a single source of brackish groundwater at the back of the Harbor was predominantly responsible for inputs. Therefore, the model discharge condition was placed in the cells along the back wall of the harbor. The quantity and salinity of the inflow as well as the dispersion coefficient were varied until the salinity contours appeared to match with reported values and the flushing time was close to 12 hours as reported in OI Consultants. It was found that the most reasonable value was 30 mgd at 22 ppt. This is close to the value reported by Gallagher (1980) of 27 mgd of brackish water entering Honokōhau Harbor.

A detailed analysis of the change in flow velocities through the harbor entrance is described within the 3D model shown in Appendix U. It was found that tidally averaged velocities through the harbor entrance may increase by 3-4 cm/s post-expansion. This is due to the increased tidal prism, the addition of the exhibit water, and the increased flow of brackish groundwater into the system.

3.9.1.2 Methodologies and Studies

Three studies were conducted to evaluate project impacts on nearshore and coastal waters. Oceanit completed a Zone of Mixing study that was presented in the DEIS and is contained in Appendix ~~H~~I. This study was tasked with determining the mixing and dispersion of flows emerging from the harbor into the adjacent shallow nearshore waters. To accomplish this, data from previous studies were reviewed and field research was conducted to measure stratification and currents adjacent to the harbor entrance and out into the ocean. A "Zone of Mixing" area was determined outside of which there is no discernable influence to water quality from the existing harbor effluent. This information was used to assess impact from modifications to groundwater inflow from marina expansion, and the seawater effluent flow from the marine water features.

~~The model analysis for mixing and water flow through the existing harbor and the proposed marina included existing water exchange between harbor and ocean and the future water exchange resulting from the expanded marina area and the discharge from the marine water features. The model results include three dimensional water flow patterns as well as water quality distribution details.~~

A Wave Penetration Study was prepared by Moffat and Nichol to determine wave characteristics within the existing harbor and the proposed expansion basin. This study was presented in the DEIS and is contained in Appendix J.

In response to DEIS comments, a Harbor Water Quality Modeling Study was prepared by Moffat and Nichol and is presented in Appendix U of this FEIS.

3.9.1.3 Zone of Mixing ~~Anticipated Impacts and Recommended Mitigation~~

~~Oceanit completed a Zone of Mixing study that is contained in Appendix H. This study was tasked with determining the mixing and dispersion of flows emerging from the harbor into the adjacent shallow nearshore waters. To accomplish this, data from previous studies were reviewed and field research was conducted to measure stratification and currents adjacent to the harbor entrance and out into the ocean. A "Zone of Mixing" area was determined outside of which there is no discernable influence to water quality from the existing harbor effluent. This information was used to assess impact from modifications to groundwater inflow from marina expansion, and the seawater effluent flow from the marine water features.~~

The model analysis for mixing and water flow through the existing harbor and the proposed marina included existing water exchange between harbor and ocean and the future water exchange resulting from the expanded marina area and the discharge from the marine water features. The model results include three-dimensional water flow patterns as well as water quality distribution details.

The three-dimensional model was extended outside of the harbor entrance in order to examine relative changes from baseline conditions. Due to the lack of available data regarding specific brackish discharge events along the coastline, the model is not calibrated outside of the harbor entrance, and any changes predicted in this region are only referred to in terms of relative changes (in relation to model predicted existing conditions). This analysis is shown in Appendix I. It was found that the significance of the additional brackish groundwater inflow into Kona Kai Ola Marina also has an effect on the surrounding surface waters of Honokōhau Bay. The concentrations of nutrients in low flow scenarios are less than existing conditions due to the lack of additional nutrients to the system. However, with higher brackish inflow, the relative growth of algae is more contained while nutrient concentrations relatively increase. Relative nitrogen concentrations in the bottom layers can be maintained in scenarios without additional exhibit flow included, however with the additional saline flow, there is more of a nitrogen load in the bottom layers.

Anticipated Impacts and Mitigation Measures

In the existing Honokōhau Harbor, water quality issues focus on the potential for pollutants, sediments, mixing and discharge into the nearshore marine waters. Before the harbor was constructed, any pollutants entrained within the groundwater were believed to have been diffused over a broad coastline.

The water for the water features will be pumped from 100 to 300 foot depth. The total amount of water supplied to the water features will be 75 million gallons per day. The rate of pumping is designed to achieve an approximate 4 hour residence time within the ponds (pers. comm. Cloward H2O, 2007) and to prevent build up of pollutants from users and marine animals. ~~The water for the water features will be pumped from 100 to 300 foot depth. The total amount of water supplied to the water features will be 75 million gallons per day. The rate of pumping is designed to achieve rapid turnover of water within the ponds and to prevent build up of pollutants from marine animals and users. Currently, the nutrient concentrations at the existing marina entrance are very high (1,200ug/l of total dissolved nitrogen (TDN) and 83 ug/l of total dissolved phosphorus (TDP)). The intake water for the features has low levels of nutrients (185 ug/l TDN and 5.6 ug of TDP).~~

The anticipated impacts and mitigation measures discussed below assume construction of an 800-slip harbor. One possible mitigation measure would be to reduce the size of the harbor expansion. Any modification of the final design size of the marina would require modification of contract language with the DLNR. In that Alternative 1 would include a smaller marina and smaller seawater lagoons, the latter of which would represent a 74 percent decrease from 19 acres in the proposed project to five acres in Alternative 1, there would be a proportionate reduction in seawater discharging into the new harbor.

The intake water for the features has low levels of nutrients (185 µg/l TDN and 5.6 µg of TDP). This amount will be modified by the generation of nutrients by marine animals. This quantity was modeled via calculations performed by ClowardH2O (pers. comm., 2007). Through modeling, this level of nutrient input was found to have an effect on both ammonia and nitrate concentrations outside of the harbor. However, the modeled input did not contribute significantly to eutrophication potential due to the limiting nature of phosphorous within the system. These processes and sensitivity tests are described at length in Appendix U.

Although the total amount of nutrients that will be generated per day will increase from the nutrient output of marine animals and users, the concentration of the nutrients will be lower due to the large amount of water available for mixing within the basin. The overall impact will be a reduction of nutrient concentration in the outflowing water.

The boats used in the marina will be small, and spills could occur from boats or while fuelling. These amounts in a majority of cases will be relatively small. The entrance to the marina is relatively narrow and in case of a fuel spill, the traffic will be stopped and a containment boom will be installed to contain the spill within the basin.

Adequate numbers of containment booms, absorption units and oil removal facilities will be at the fueling station and also provided to an identified emergency response station. Personnel will be trained to respond in case of a spill. In addition, the local fire station, police and civil defense and other agencies will be informed in case of a larger spill.

The proposed new marina would significantly increase the size of the water body, but would utilize the existing marina entrance for access to the ocean. This will increase the tidal prism in addition to the extra anticipated inflows to the new marina. It would be expected to intercept additional groundwater, adding these flows to the existing harbor outflow in addition to being the outfall location for the exhibit flows. Model results presented in Appendix U show that the increase in depth-averaged velocities through the harbor entrance can be as great as 4 cm/s under typical conditions,

The proposed marina basin will therefore not result in any significant increase in groundwater flow to the coastline, but rather a concentration and redirection of the existing flows to the harbor entrance. There will be an expanded zone of mixing between the brackish effluent and the surrounding ocean waters due to the concentration of flows at the harbor mouth. The addition of effluent water from the marine water features will result in an additional increase outflow across the marina entrance from 30 mgd to an expected value of greater than 135 mgd after development of the marine water features. ~~to the south will intercept additional groundwater, adding these flows to the existing harbor outflow. The proposed marina will therefore not result in any significant increase in groundwater flow to the coastline, but rather a concentration of the existing flows to the harbor entrance. There will be an expanded zone of mixing between the brackish effluent and the surrounding ocean waters due to the concentration of flows at the harbor mouth. The addition of effluent water from the marine water features will result in an additional increase outflow across the marina entrance from 4 mgd at present to 79 mgd after development of the marine water features. The effluent from the marine water features will contain low amounts of nutrients because of the high flow through. The large amount of water will dilute any pollutants that enter the harbor basin from groundwater or surface water. This will improve the water quality and will be a positive impact on the nearshore environment.~~

Despite its proximity to the WWTP, sewers do not service the existing adjacent State harbor or surrounding private structures. All sewage from existing facilities is treated in on-site septic systems with resulting effluent flowing to groundwater that almost certainly flows directly to the existing harbor. Under post-development conditions all of these flows would be connected to the Kona Kai Ola sewage system resulting in a positive impact by eliminating this existing pollutant load into the harbor. Sewage from facilities at the existing marina will be connected to the Kona Kai Ola sewage system. Sumps, connection lines and pumping facilities will be constructed to move the sewage from the present septic tank systems directly to the larger collection system. The work needed for this conversion will be included in the sewage infrastructure design and construction.

~~Hydrogeological studies have concluded that the expansion of the marina does not increase the groundwater flux through the harbor mouth into the ocean significantly. The groundwater from the brackish aquifer already converges to the existing harbor and does not show flow across the planned marina basin area into the ocean.~~

~~It is estimated that the average groundwater discharge is 3 to 4 million gallons per day (mgd). The salinity of the water that discharges from the brackish aquifer is about 12 percent of seawater or about 4.3 parts per thousand (ppt). In addition, 52,000 gallons per minute of surface seawater (36 ppt) will be pumped from the nearshore area for use in the marine lagoon features. This amounts to approximately 75 mgd. This water eventually is discharged into the harbor basin and into the ocean. This water is not expected to reach the existing marina basin because the proposed basin connects to the existing one very close to the common entrance. Therefore the impacts to the existing marina environment from the additional discharge are expected to be negligible.~~

At present, the salinity of the water column remains entirely saline in the bottom layers with more brackish influences near the surface (about 30 ppt). Model results displayed in detail within Appendix U show that salinity differences near the harbor entrance are completely confined to the surface layers and are at maximum about 0.5 ppt less than the current conditions of about 30 ppt (surface). Salinity at the marina entrance, at 10 foot depth is not affected by the brackish water discharge. The benthic flora and fauna close to the marina entrance and at less than 10 feet water depth face variations of salinity from 34.5 ppt to 36.0 ppt.

~~At present the depth averaged salinity of the water exiting the existing basin is about 33.5 ppt close to the marina entrance. The brackish water stays at the surface and shows its influence for distance of about 2,000 feet. Salinity at the marina entrance, at 10 foot depth is not affected by the brackish water discharge. The benthic flora and fauna close to the marina entrance and at less than 10 feet water depth face variations of salinity from 34.5 ppt to 36.0 ppt.~~

~~A straight forward mass balance calculation shows the following changes to the existing flow and salinity. The average outflow from the harbor will increase from 4 mgd to 79 mgd. The salinity of the water will change from an average of 33.5 ppt to about 34.4 ppt. The water will still be less dense, and the depth of impact will be limited to the surface 3 to 4 feet. The benthic flora and fauna will face a smaller variation in salinity that will discourage opportunistic biota dominance and lead to a healthier and more diverse benthic community. This is a positive impact on the benthic environment. The increase in the outflow will cause a very slight increase in water velocities, but this is well below the existing velocity variations in the entrance channel vicinity.~~

Construction of a new marina basin will have ~~short-~~short-term negative impacts on coastal marine resources. Direct construction impacts are likely to be small. Marina construction will be accomplished with a berm separating the construction area from adjacent marine waters, minimizing the discharge of sediment from excavation and dredging. Excess sediment remaining in excavated marina will be removed before the land bridge is removed in order to minimize any temporary sediment plume. When the final land bridge is removed, a temporary sediment plume is anticipated. Silt curtains will be used to ~~minimize the~~prevent suspended sediment entering ocean waters.

Although the runoff at the site is small due to the dry climate and the high porosity of the land, during high rainfall, some runoff might reach the harbor basin as overland sheet flow. The new marina will serve as a collection point for materials utilized or generated at the development site, either through direct runoff or by interception of groundwater flow. There is the potential that fertilizers, pesticides, petroleum products, road wastes, etc, could be discharged from the mouth of Honokōhau Harbor into the coastal marine environment. Structural Best Management Practices (BMPs) will be designed and installed to remove as much of pollutants as possible from the run off during such unusual conditions.

Small boat harbors have been found to be consistent sources of certain types of pollutants to the surrounding environment. These pollutants in general include:

- Heavy metals (zinc, copper, tin, lead) associated with bottom paint or sanding of painted surfaces during maintenance activities;
- Petroleum product release from fueling operations, and bilge discharges exacerbated by the large number of boats and range of operator skills;
- Trash and debris from boat operations and surrounding harbor activities;
- Sewage from intentional or accidental releases from on-board waste systems;
- Biological waste from fish cleaning;
- Waste streams from land-side boat washing and maintenance activities;

Most of the impacts can be minimized through the use of Best Management Practices (BMPs), which are a combination of activities, education and devices that help prevent or reduce water pollution. A “Clean Marina Program” similar to the International Blue Flag Marina Program or the Clean Marinas California Program will be implemented at the new marina and include key elements such as promoting and enforcing:

- Boater education signage, literature and programs
- Emergency and spill response plans
- Safe fuel, hazardous material, sewage and bilge water handling practices
- Use of sewage marina pump out, waste and oil recycling facilities
- Environmentally sensitive boat maintenance and cleaning practices
- Environmentally sensitive hull cleaning practices
- Good housekeeping practices on boats and docks
- Use of fish cleaning stations / receptacles and fish waste composting

- Enforcement of harbor rules and regulations

3.9.1.4 Wave Impacts to the Existing Honokōhau Harbor

The wave climate within the existing Honokōhau Harbor and the proposed marina was analyzed using a numerical model that is further discussed in Appendix J~~I~~. A wave measurement study was conducted to determine the wave response of the existing harbor to outside wave climate. A directional wave gage at a depth of sixty feet directly in front of the existing harbor entrance and a non directional wave gage inside the existing harbor basin were installed to measure wave climates simultaneously. The results of the wave measurements were provided for wave transformation model calibration.

Results of the wave climate analysis with and without the expansion were used to predict wave agitation impacts to the existing harbor. The model was operated for waves with a 9-second period and swells of 13-second period as the dominating waves for the offshore area.

Anticipated Impacts and Proposed Mitigation

Wave climate in the existing harbor from the proposed marina construction depended on the period of the incoming waves. There was a slight decrease in the wave height in the existing basin for outside waves of a 9-second period. For longer period swells, there was no significant change in the wave height in the basin.

For waves with a 9-second period, the wave height at the inner end of the outer basin attenuated to 40 percent of the incident wave. There was no additional wave attenuation due to the presence of the proposed marina. Within the existing harbor inner basin, the wave height attenuated to about 20 percent of the incident wave. The wave height in the inner harbor decreased by about 10 percent with the construction of the proposed marina.

For longer period swells, the wave height in the outer basin remained at 50 percent attenuation. In the inner basin, the wave height reduced to about 20 to 30 percent of the incident wave. There was no significant change in the wave height in the inner basin from marina construction.

The analysis shows that under short storm wave conditions, the proposed marina construction causes a positive impact by reducing the wave height by 10 percent in the existing marina. However, under swell conditions there is no change in wave agitation in the mooring area of the existing harbor with the proposed marina. Overall, the impact of construction of the proposed marina basin is positive since the existing harbor will experience less wave agitation. This may be due to the fact that the amount of wave energy entering through the harbor entrance remains the same, while additional water area and frictional surfaces (both sides and bottom) provide for greater wave dissipation after the expansion. No mitigation is ~~recommended~~ proposed due to the project’s positive effect.

3.9.1.5 Harbor Water Quality

A three dimensional hydrodynamic and water quality model of Honokōhau Harbor and its surrounding waters was developed using the Delft3D modeling suite and is described in detail in Appendix U. The model was driven at its offshore boundaries by tidal predictions, and calibrated to reproduce available measurements of water levels, currents, salinity and temperature.

Model results suggested that the brackish groundwater inflow to Honokōhau Harbor was approximately 30 million gallons per day (mgd), with an average salinity of 22 parts per thousand (ppt), in order to reproduce the salinity profiles observed from a number of available data sets. In addition, this flow rate is in very good agreement to the published values of brackish groundwater inflow to Honokōhau Harbor. The model also showed that under these conditions, Honokōhau Harbor maintained a flushing time of approximately 12 hours, which is consistent with available studies and data. The flushing within the harbor was found to be primarily due to the density currents that result from the salinity gradient within the Harbor created by the brackish groundwater inflow. This finding also corroborated with study findings that this flushing mechanism results in water exchange in the harbor on the order of seven times faster than if it were flushed via tidal action alone.

A water quality model was developed to replicate typical conditions experienced in Honokōhau Harbor and its environs. Water quality parameters were calibrated and validated using two available datasets. It was found that the water quality within Honokōhau Harbor is primarily maintained due to the high rate of circulation. The nutrient loads entering the harbor through the brackish groundwater inflow are high, and without high flushing, water quality within the Harbor would not be able to be maintained.

Anticipated Impacts and Mitigation Measures

The water quality model was applied to predict the post-project conditions after the addition of the Kona Kai Ola Marina. Per the Conceptual Master Plan, the marina consists of a 45 acre marina basin with 800 boat slips. Brackish groundwater inflows into the new marina basin were bracketed between 0 mgd and 60 mgd. The two simulated extremes represent scenarios where no additional brackish groundwater will be intercepted by the new marina, which is not consistent with the observed conditions, and when brackish groundwater inflow into the new marina is twice the amount that will be still flowing into the existing marina, respectively.

The model results demonstrated, relative to the increased area, that water quality within the proposed 45-acre marina basin system could not be maintained. Inflow of brackish groundwater to the new marina was found to be fundamental to the flushing and water quality of the proposed system. However, even for the largest simulated inflow of 60 additional mgd entering the new marina, water quality was still degraded post-expansion. This is primarily due to the fact that the proposed marina basin has five times the volume of the existing harbor. In addition, the geometry of the system led to internal circulation between the existing harbor and new marina basin. The 45-acre new marina basin only becomes viable from a water quality impact standpoint if the additional brackish groundwater inflow into the new marina exceeds 60 mgd.

Alternatives to the aforementioned system that could maintain the flushing and water quality, as observed under existing conditions, were investigated. It was found that the reduction of the volume of the new marina basin by 45 percent significantly improved the flushing and water quality. Broad range sensitivity tests were also performed to determine the effect that various parameters had on the proposed system. For example, addition of nitrogen and phosphorous loads were tested to determine the limitation of the system.

The conditions with the project constructed were found to be phosphorous limited. Several simulations were performed including and excluding the inflow from the marine exhibits which provides an additional nitrogen load and also varying the location of this inflow. It was found that the inflow from the marine exhibits can have a beneficial effect on flushing, especially when positioned within the existing harbor basin. However, its effect is significantly less than the effect due to the brackish groundwater inflow. When the exhibit inflow is excluded or positioned at the east end of the new marina, its effect is small in terms of flushing due to its high salinity. From a water quality perspective, since the loads from the exhibit inflow consist primarily of nitrogen, it does not cause increased algae growth. However, this exhibit inflow does raise the concentrations of ammonia and nitrate in the system.

Simulation results indicate that under the conditions when the post-expansion system receives an additional brackish inflow into the new 25-acre marina on the order of 30 mgd or more, water quality within the harbor system and in the surrounding waters remained similar to existing conditions. These conditions are expected to occur based on the findings reported by Waimea Water Services (2007), which states that the proposed marina would exhibit the same or similar flushing action as the existing marina.

An additional mitigation measure proposed by Waimea Water Services (2007), if sufficient inflow is not intercepted, consists of drilling holes in the bottom of the new marina to enhance this inflow and facilitate flushing within the proposed system.

~~3.9.3~~3.9.2 Anchialine ~~Ponds~~ Pools

Two studies on anchialine pools were conducted in this EIS process. The anchialine ~~ponds~~ pools water quality studies and ~~biota surveys were conducted by David A. Ziemann, Ph.D. of the Oceanic Institute and is~~biota surveys were conducted by David A. Ziemann, Ph.D. of the Oceanic Institute in October 2006 and are included as Appendix ~~G~~H-1. That survey included pools located both north and south of Honokōhau Harbor. In response to DEIS comments and to further study the pools south of entrance channel of Honokōhau Harbor, a second study was conducted by David Chai of Aquatic Research Management and Design in June 2007. The second survey focused on intensive diurnal and nocturnal biological surveys and limited water quality analysis of the southern group of anchialine pools exclusively. The report is contained in Appendix H-2.

~~3.9.3.1~~3.9.2.1 Existing Conditions

Anchialine ~~ponds~~ pools exist in inland lava depressions near the ocean. Two anchialine ~~pond~~ pool complexes are located immediately to the north and south of the Honokōhau Harbor entrance channel. The complex to the north is located wholly within the designated boundaries of the Kaloko-Honokōhau National Historical Park as shown in Figure Q~~O~~. Many of the ~~ponds~~ pools in the southern complex are within the park administrative boundary as well. ~~Ponds~~ Pools in the northern complex show little evidence of anthropogenic impacts. Many contain typical vegetation and crustacean species in high abundance.

Figure R locates anchialine pools near the harbor entrance and pools~~Ponds~~ in the southern complex are depicted in Figure S.

Attachment 2-A

KONA KAI OLA MARINA
HARBOR WATER QUALITY STUDY

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June, 2007

APPENDICES

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1. INTRODUCTION

Jacoby Development, Inc. has selected Moffatt & Nichol (M&N) to develop and apply a numerical hydrodynamic and water quality model of the existing Honokohau Harbor and the proposed development. This new development, Kona Kai Ola, is an environmentally sustainable marina featuring a mix of uses including: visitor and resident-serving commercial enterprises, hotels and time-share units, marina services, and open space and community-benefiting facilities (such as public infrastructure improvements) in a pedestrian-friendly setting surrounding the marina and seawater lagoons. The proposed Kona Kai Ola Conceptual Master Plan includes a new 45-acre 800-slip marina that shares the entrance to the ocean with the existing Honokohau Harbor.

This report presents the development and calibration of a three-dimensional hydrodynamic and water quality numerical model of Honokohau Harbor, Kona Kai Ola and the surrounding coastal areas using a state-of-the-art numerical modeling system. Existing hydrodynamic and water quality conditions have been accurately reproduced with the numerical model, which indicated that the model can be used as a tool to predict the hydrodynamic and water quality conditions expected after construction in the new harbor system. A large number of future scenarios have been simulated with the numerical model in order to predict changes in water quality conditions after construction of the development. The model was also used to identify possible modifications to the conceptual master plan for the marina that could lead to acceptable water quality conditions of the new marina system.

2. WATER QUALITY AT HONOKOHAU HARBOR (1975-2006)

The historical data for specific water quality and hydrologic parameters for the Honokohau Harbor near the Kaloko-Honokohau National Historical Park, Hawaii are presented concisely in the following sections. The Harbor was built in 1970 and expanded in the late 1970's. Monitoring had been on-going for five years following the completion of the initial construction (1970-1975). The monitoring was performed with the purpose of investigating the resulting water quality conditions in addition to examining the colonization and ecological development within the Harbor. Because of the isolation of the Harbor from developments (absence of National Pollutant Discharge Elimination System-permitted dischargers (point source) and river/stream runoff (nonpoint source) within two miles of the Harbor), the Harbor provided a unique opportunity to "delineate valuable ecological cycles and describe important phenomena that may influence…coastal developments of this sort" (Bienfang, 1980). In short, baseline conditions were monitored and documented for future reference. Subsequent to these conditions, more recent studies have indicated that the Harbor's water quality has apparently improved since the post-construction survey. This conclusion is based upon increased dissolved Oxygen (DO)[1] for the temperature/salinity regime. Several benchmark parameters were used in this assessment to evaluate the DO improvements: ortho-phosphate (o-P)[2], nitrate-nitrogen (NO_3-N), ammonium-nitrogen (NH_4-N), Chlorophyll a (CHLa) and reactive Silica (Si).

The information collected and compiled by Bienfang (1980) and Bienfang and Johnson (1980) provide baseline information that will enable the State and other agencies to distinguish between background (pre-1980) and future man-made loadings/impacts. It is important to note that the studies (Bienfang, 1980 and Bienfang and Johnson, 1980) do not provide insight as to undisturbed conditions, as the harbor is a man-made entity in and of itself. These conditions only represent baselines in the sense that they describe conditions before the expansion conducted in 1978, and help to clarify and identify impacts after this time The results of the baseline assessment will be utilized to determine whether subsequent development in and near the harbor has resulted in degradation of the water quality since the expansion in 1978.

2.1 Harbor Waters

It was necessary to characterize water quality at specific sites throughout the Harbor in terms of vertical location in the water column, tidal cycle (when available) and time. Only small amounts of data were available for the Baseline and subsequent studies. Other complications precluded direct comparisons of the datasets[3], however, the relative changes in the water quality benchmarks are discussed. The applicable stations and benchmark concentrations for each study are presented in Appendix A (Figure A-1 through A-4 and Table A-1 through Table A-2, respectively).

[1] The DO degradation benchmark will be presented as % DO Deficit, the difference between the saturation DO for the specified temperature and salinity, and the measured DO.

[2] Orthophosphate is the dissolved form of phosphorous that is immediately available for bio-uptake.

[3] Bienfang (1980) presents datasets as arithmetic means with standard deviations for various depths (0.5 m from surface, 1.5 m and 3 m) at four Harbor sites and one outside the mouth of the Harbor (to represent oceanic conditions/control). OI Consultants (1991) presents results from seven Harbor stations and various outside stations for surface (0.5 m from the surface), mid-depth (variable) and bottom (variable) for low and high tides. Ziemann (2006) presents samples at eight stations throughout the Harbor for surface (0.2 m from the surface) and bottom (0.5 m above the bottom), without a tidal cycle designated.

2.1.1 *Dissolved Oxygen (DO)*

Baseline DO concentrations are of major concern as they show how the oxygen content was affected by the addition or subtraction of nutrients or other effects. Dissolved oxygen content is often used as an indicator of overall water quality. DO concentration is a response to various sources and sinks of which numerous relationships exist, including those listed in Table 2-1. Dissolved oxygen is depleted by oxidation of organic carbon, benthic oxygen demand, nitrification and respiration, and is replenished through phytoplankton production and reaeration at the surface.

Table 2-1: Summary of DO sinks and sources

DO SINKS (CONSUMERS):	
1.	Deoxygenation of biodegradable materials by bacteria and fungi;
2.	Benthic oxygen demand, utilizing oxygen in the upper, oxygenated (aerobic) layer of sediment;
3.	Nitrification of ammonia and organic nitrogen to nitrites and nitrates; and
4.	Respiration[4] by micro algae and macrophytes.
DO SOURCES (PRODUCERS):	
1.	Reaeration at the air-water interface, and
2.	Photosynthesis by the algae and macrophytes.

As a substance enters the water body, constituents either dissolve, settle, or are suspended in the water column for later dissolution, degradation or settling. Soluble constituents such as ammonium, may create "hot spots" of DO depletion, in which water column bacteria immediately seize the constituents as a food source, requiring large amounts of oxygen to degrade the materials. The strength of these materials is usually measured as biochemical oxygen demand (BOD). The BOD effect may be further qualified as carbonaceous or nitrogenous oxygen demands (CBOD or NBOD, respectively), depending upon the energy source in the waste (carbon or nitrogen) utilized by the consuming bacteria.

While "nutrient" effects are generally spoken of with respect to algal production, in reality, the mechanisms of nutrient loading and consequent degradation of the system are significantly different. Ammonium (NH_4) will quickly oxidize to nitrate, requiring 4.57 g-O/g-N, the theoretical oxygen demand for nitrification to NO_3,[5] exerting an immediate oxygen demand in the water column. Nitrate (NO_3) and ortho-phosphate (o-P)[6] are already oxidized, and do not exert

[4] Respiration is the consumption and decomposition of heterotrophs (animals, bacteria and fungi)/ rate of destruction of organic matter in the water column.

[5] Overall, 2 moles of O_2 are required for each mole of ammonia oxidized:

Oxygen required:	2 moles * 32 g-O/mole = 64 g
Ammonia to be oxidized:	1 mole * 14 g-N /mole = 14 g
	64/14 = **4.57** g-O/g-N

[6] "Phosphate" referred to in the Baseline study (Bienfang 1980) is actually ortho-phosphate, which is bio-available, inorganic phosphate.

an oxygen demand. However, they are plant nutrients and whether nitrogen or phosphorous is found to be the limiting factor in algal growth, eutrophication can become a problem. Eutrophication can often be referred to as "overfertilization" of a water body. Originally, this was used to describe the natural progression of a lake to a marsh to a meadow, however the term has been more predominantly used to describe the accelerated aging of a water body, whereby plant-growth within the water body exceeds the expected natural conditions due to human activities (Chapra, 1997)

Detrimental effects to water bodies due to eutrophication can include the excessive quantity of plant growth decreasing the water clarity and species naturally found in the water. In addition, the growth and respiration of plants can affect the oxygen and carbon dioxide levels within the water body. This can affect fish populations. The change in trophic state of the water body significantly affects the entire natural population within the water body, and in the case of Honokohau Harbor could have significant impacts on the coral populations present within the Harbor (Costa *et al*., 2000).

In classic eutrophication scenarios, the waters experience high "nutrient" levels, resulting in algae blooms, die-off, and sedimentation with subsequent unsatisfied benthic oxygen demand, leading to a DO collapse in the water column (EPA, 1985). In the Harbor water column, due to density stratification, algae that dies and falls out of, or is carried away from, the system remains out of the system. A review of the sediment samples[7] (Bienfang, 1980) reveals little organic matter on the bottom, indicating that algae do not die in sufficient numbers to build up an organic blanket on the bottom, and mineralization or denitrification are not contributing to the nitrate in the water column[8]. This is likely due to the high degree of flushing through the existing harbor. Thus, Harbor DO deficit is expected to be primarily from nitrification of $NH_4 \rightarrow NO_3$ and algal respiration.

In the Baseline Harbor study (Bienfang 1980) DO values are considerably lower than the respective DOSat[9] for the temperature and salinity at each station and depth. DO deficits range from 44% below DOSat in the Back Basin surface samples (0.5 m depth) to 24% below DOSat in the ocean samples (5 m depth)[10]. By 1991, the Harbor DO deficits indicate significant improvement; and in 2006, grab samples by Ziemann, corroborate this observation. Mid-Harbor

[7] % Organic materials in sediment cores were tested. Values were extremely low, ranging 0.79-2.81%, were determined to be primarily inorganic, and showed no spatial distribution or trends

[8] During mineralization and de-nitrification, organic nitrogen (from dead algae) is broken down at the soil: water interface. If oxygen in the bottom is in small quantities, NH_4 may be returned to the water column, oxidize to NO_3 and continue the cycle of DO demand and fertilization. In an anoxic bottom environment, N_2 may be formed during the process of de-nitrification and may result in N_2 bubbles leaving the water column through release into the air.

[9] DOSat = -139.34411 + (1.575701 x 105 / T) – (6.642308 x 107 / T2) + (1.243800 x 1010 / T3) – (8.621949 x 1011/T4) - Chlorinity[(3.1929) x 10-2) – (1.9428 x 101 / T) + 3.8673 x 103 / T2)]

where: T = deg. Kelvin
Chlorinity = salinity / 1.80655

[10] Hawaii WQ standards require minimum DO concentrations $\geq$ 75% of DOSat. Both the Back and Front Berthing Basins (stations 1 and 3, respectively) failed this standard in surface samples.

surface DO deficits have improved from a maximum of -44% (1980) to -26% (1991) to -15% (2006) with the greatest improvement seen towards the back of the Harbor.

2.1.2 *Nutrients (NH_4, NO_3 and o-P)*

A review of the Baseline nutrient data showed that soluble nutrients are variable throughout the Harbor. Maximum NO_3-N, o-P and NH_4-N concentrations were observed during ebb tide, surface samples of the Back Berthing Basin in the Baseline study (Bienfang 1980). Since, for all depths, nutrient concentrations are higher toward the back of the Harbor and become lower along Transect A-A' (Figure A-1) towards the ocean (as a result of tidal flushing/dilution), the source of nutrients appears to be in or near the back of the Harbor, corresponding to groundwater inflow.

Ammonium (NH_4)

Ammonium concentrations have decreased in the Harbor over time from the mid-Harbor maximum of 18.8 µg-N/L in the Baseline dataset (Bienfang, 1980) to a minimum[11] of <1 µg-N/L in the 2006 study (Ziemann 2006). Mean values in the Harbor (18.8 µg-N/L) and in the groundwater (14 µg-N/L) will each require < 0.09 mg O/L oxygen to fully oxidize $NH_4 \rightarrow NO_3$. These loads are insufficient to explain the high Harbor DO deficit calculated during Baseline or subsequent conditions. It is probable that the source of NH_4-N is not being characterized by the sampling sites (too variable or not near enough to the source), or it is loaded through an intermittent inflow, such as a rainfall/runoff event. It is also possible that other sources of oxygen demand are present.

Figure 2-1 shows the NH_4-N differences over the eight stations described in Ziemann (2006). It can be seen that in 1991, there is a significant increase in concentration between stations 4 and 6. This indicates that there could be an input into the system around this area. Suspected NH_4-N inputs into the Harbor include: septic sources, anchialine ponds and wildlife. From the historic data, inflows are also apparent at locations mid-Harbor and near the mouth. Mid-Harbor measurements (approximately between Ziemann (2006) stations 4 and 5) correspond to inflow from two restroom facilities: 1) between the Harbor Back and Front Berthing Basins and 2) north of the Harbor on the Honokohau Beach in the National Park (Hoover and Gold, 2005). The concentrations of NH_4 from these suspected sources are expected to be higher than that measured in groundwater; however, no corroborating inflow data has been collected at these sites.

[11] Ziemann (2006) provided only grab samples for the Harbor – one sample at each of the sites for the surface and bottom depths, so the single observations may not be representative of the Harbor water quality.

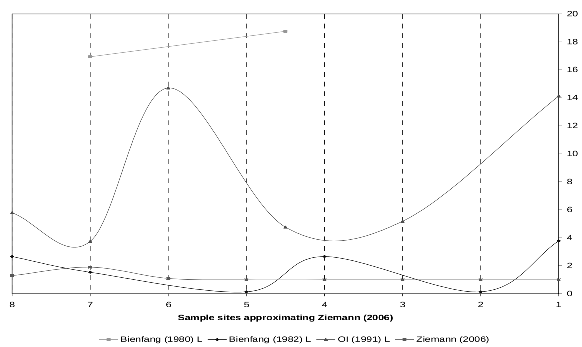

Figure 2-1: Ammonium surface concentrations

Nitrate (NO_3)

Nitrate concentrations have increased over time, where the lowest concentrations were measured in 1991 (OI, 1991) and the highest in 2006 (Ziemann, 2006). In addition to the nitrification of NH_4 as a source of NO_3-N in the Harbor, the dominant source of nitrogen in the Harbor is from groundwater[12]. Thus, characterization of this major source is critical to understanding the water quality evolution in the Harbor. One characteristic value for both NO_3-N and o-P in groundwater was provided in the Baseline study (Bienfang, 1980). Concentrations are significantly higher for groundwater than within the Harbor itself, but there are insufficient data to characterize the "groundwater signature" for the baseline conditions. Supplemental studies were consulted to provide additional characterizations of groundwater into the Harbor (Waimea Water Services, 2006 and Hoover and Gold, 2005). Marked variations in concentrations were seen across the sampled wells; however, using values nearest to the Harbor (Waimea Water Services, 2006), the values were fairly consistent with Bienfang (1980). In addition, the groundwater was studied by Hoover and Gold (2005) and nutrients were found to have a linear relationship with salinity. This corroborates the discussion by Oki *et al*. (1999) which describes the groundwater system with respect to oceanic inflow. This is further discussed in the hydrodynamics section. However, it suffices to say that a linear relationship of the nutrients found in the groundwater with salinity also corroborates values found by Bienfang (1980) and Waimea Water Services (2006).

If groundwater, which is the primary load of NO_3-N into the Harbor, is constrained to the average concentrations that were collected, the Harbor NO_3-N values would be expected to be lowered significantly because of dilution. Dilution was sufficient to explain the Harbor NO_3-N concentrations at most sites. Unexplained increases in NO_3-N in mid-Harbor suggest that additional NO_3-N is being "created" in the Harbor from nitrification of $NH_4 \rightarrow NO_3$ or loaded directly into the Harbor. Thus, the loading of NH_4-N into the Harbor must be higher than the groundwater NH_4-N measurements suggest, or there are additional unidentified loads of NH_4-N

[12] Bienfang (1980) states that coastal groundwater is high in NO_3 due to the geochemistry of the confining layer.

or NO_3-N flowing into the Harbor. Nitrate inflows are apparent in several studies at mid-Harbor stations (between Ziemann stations 4 and 5), corresponding to a restroom facility between the Back and Front Berthing Basins) and near the mouth (between Ziemann stations 6 and 7 (Ziemann, 2006)) as is shown in Figure 2-2.

Figure 2-2: Nitrate surface concentrations

Orthophosphate (o-P)

Phosphorus is one of several macronutrients required for the growth of marine organisms. In open ocean marine ecosystems, phosphorous is often present in low and, often limiting, concentrations for microalgal and bacterial populations. In the assessment of phosphorous from the various studies in the Honokohau Harbor, "phosphorous," "phosphate," "orthophosphate" and "soluble reactive phosphorous (SRP)" were measured. Identification of the analytical methods used for all samples indicated that the constituent measured, in all cases, was inorganic ortho-phosphate (o-P)[13].

Ortho-phosphate in the Harbor has decreased over time. The highest concentrations were measured in the Baseline study (Bienfang 1980 and 1982). The values decreased in 1991 and are at their lowest in 2006. These reductions in Harbor concentration imply that o-P loading has decreased, possibly due to improvements in nearby wastewater systems. An unidentified load of o-P is introduced near the Harbor mouth (between Ziemann stations 6 and 7), which is shown in Figure 2-3. The slight increases seen in Ziemann (2006) and OI Consultants (1991) are unattributable. They could be due to any number of factors; however, the fact that they do occur in two datasets indicates that it is not a data anomaly, but some sort of consistent source of nitrate and phosphate at this point. Stations 6 and 7 are located in different areas of the Harbor, with 6 being located in a narrow channel connecting the front and back berthing bays. Station 7 is located in a cul-de-sac of sorts immediately outside of this narrow channel. It could be that

[13] Orthophosphate is the dissolved form of phosphorous that is immediately available for bio-uptake.

there is a nutrient source near to this cul-de-sac, however it cannot be determined from this data what this source may be.

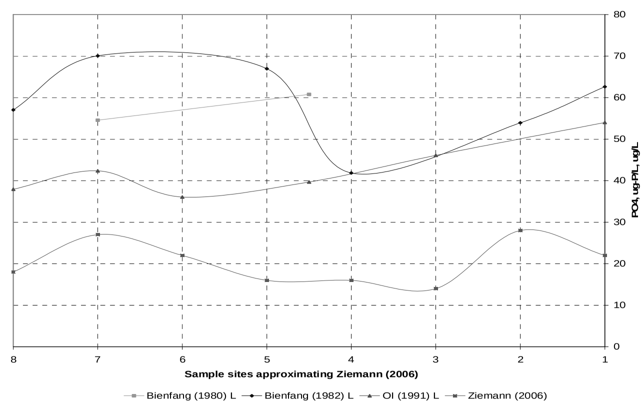

Figure 2-3: Phosphate surface concentrations

2.1.3 Supplemental Documentation for Source Loads

<u>N:P Ratio</u>

The nitrogen to phosphorous ratio (N:P)[14] is revealing as an indicator of pollutant origin. In nitrogen-limited waters (where nitrogen is the limiting nutrient), this ratio is expected to be <7.2:1 (Chapra, 1997). Waters where N:P>7.2:1 indicate that phosphorous is the limiting nutrient. Where nitrogen is severely limited, nitrogen-fixation[15] by blue-green algae may occur. In waters receiving wastewater effluent, the ratio is about 4 or 5:1 (Thomann and Mueller, 1987 and Chapra, 1997).

Chapra (1997) claims that typical marine waters and estuaries have an inorganic nitrogen to inorganic phosphorous ratio of about 2. However, in the waters offshore of Honokohau Harbor, the ratio of inorganic nitrogen to inorganic phosphorous is about 7.5 indicating that the system is fairly neutral as to its limiting nutrient.

[14] Literature states that the stoichiometric ratio of C:N:P taken up by algae during photosynthesis is 106:16:1 and the stoichiometric composition of the diatom and the typical green algae is O:C:N:P (109:41:7:2:1). (Chapra, 1997)

[15] This species of algae "fix" nitrogen directly from the atmosphere. This is considered a "nuisance" algae in managed waters, but may be essential in naturally nutrient-poor waters.

The N:P relationship for the waters within the Harbor and groundwater sources ranged in the region of 6:1-10:1[16] for all datasets (indicating nitrogen-limitation), except for the grab samples presented by Ziemann (2006), in which N:P ranged from 14-30 in surface samples and from 12-40 in bottom samples. The Ziemann (2006) data suggest that the system has become significantly phosphorous-limited since the 1991 intensive survey.

<u>Bacteria</u>

Enteric bacteria levels (total coliform, TC; fecal coliform, FC; and fecal streptococci, FS) in the water column are indicators of sewage contamination. The nature and source (human versus nonhuman) of the contaminants can be ascertained through measurements and ratios of the constituents. Waters that have ratios of FC/FS >1 are more likely to have been contaminated by human wastes. Bienfang and Johnson (1980) pointed out that possible sources of nitrogen and bacteria in the Harbor were from nearby "leaking/leaching septic sources and wildlife usage".

Except for the connecting channel between the Back and Front Berthing Basins (mid-Harbor), most stations indicated non-human origins. However, the increased bacterial counts and FC/FS ratios>1 in the Berthing Basins, indicates that sewage effluents are leaching from the septic facility near this location, because of the permeability of the lava walls within the Harbor (Bienfang, 1980).

2.1.4 Algal Responses (Chlorophyll a)

Algae (phytoplankton) affect the DO through photosynthesis and respiration. Diurnal DO measurements are usually made to verify and quantify the impacts of eutrophication. These data are not provided in Bienfang and Johnson (1980), but Primary Production was calculated and presented. Overall, the Harbor contains low phytoplankton biomass (measured as CHLa). CHLa is lowest in the brackish surface layer (0.5 m), increasing with increased salinity and warmer temperatures found at the lower depths. CHLa is highest in the mid-Harbor (Back Basin, approximately in between stations 4 and 5 of Ziemann (2006)) at the 1.5 m and 3.0 m depths, followed by the connecting channel (approximately between stations 5 and 6 of Ziemann (2006)) and falling off at the Front Basin (approximately at station 7 of Ziemann (2006)). In the Back Basin the measured values (weight and numbers) were about 28 times higher than those measured in both the Front Basin and the Ocean/control sampling stations (Bienfang, 1982). It appears that the phytoplankton select for the more quiescent conditions in the back basin at mid-depth (1.5 – 3.0 m depth) which optimizes salinity, temperature, light, and nutrients as observed in Bienfang (1982) and OI Consultants (1991). Pheophytin (a breakdown product of CHLa) was measured, yet provided no additional information or trends.

As a result of photosynthesis, algae strip CO_2 from the water column, resulting in increased pH, which is another indicator of eutrophication. Bienfang and Johnson (1980) verified that pH values were highest in samples taken at 3 m depths (corresponding to maximum CHLa measurements), but did not present data. Lowest pHs were found in the brackish surface samples (0.5 m depth), which is also not surprising due to generally low pH in groundwater.

[16] Bienfang (1980) discusses ratio N:P=15 within the groundwater, which is the ratio in the unconverted/non-normalized datasets (ug-atom/L), whereas the actual N:P ratio is approximately 7.

Regardless of tidal cycle or area of highest loading (Back Basin), the turbidity is greater than 90% transmittance, indicating that the high flushing is maintaining the water clarity (Bienfang and Johnson (1980)). Bienfang (1982) claims that the source of most of the turbidity within the water column is due to phytoplankton, and that post-expansion, the areas within the expanded harbor were most turbid. The clarity of the water allows penetration of light to deeper depths and acts as an enhancement to algal and coral growth.

3. HYDRODYNAMIC MODEL DEVELOPMENT

3.1 Overview of Delft3D Modeling System

Modeling was performed using the Delft3D modeling system. Delft3D, which was developed by WL| Delft Hydraulics, is a state-of-the-art integrated surface water modeling system based on a flexible framework capable of simulating two- and three-dimensional interactions between flow, waves, water quality, ecology, sediment transport and bottom morphology. The system gives direct access to state-of-the-art process knowledge, accumulated and developed at one of the world's oldest and most renowned hydraulic institutes. Delft3D consists of a number of well-tested and validated modules, which are integrated with one another.

The Delft3D FLOW module was specifically used to simulate the hydrodynamics of Honokohau Harbor. This module is capable of simulating two-dimensional (2D, depth-integrated) or three-dimensional (3D) unsteady flow and transport phenomena resulting from tidal and/or meteorological forcing, including the effect of density differences due to a non-uniform temperature and salinity distribution (density-driven flow). This model can be used to predict the flow in shallow seas, coastal areas, estuaries, lagoons, rivers and lakes. It aims to model flow phenomena where the horizontal length and time scales are significantly larger than the vertical scales. When the fluid is regarded as vertically homogenous with respect to temperature, salinity, and thus density, a depth-averaged approach is appropriate.

Delft3D-FLOW's system of equations consists of the horizontal equations of motion, the continuity equation and the transport equations for conservative constituents. The equations are formulated in orthogonal curvilinear coordinates. In curvilinear coordinates, the free surface level and bathymetry are related to a flat horizontal plane of reference. Flow forcing may include tidal variation at the open boundaries, wind stress at the free surface and pressure gradients due to free surface gradients (barotropic) or density gradients (baroclinic). Source and sink terms are included in order to model the discharge and withdrawal of water. Delft3D-FLOW solves the Navier-Stokes equations for an incompressible fluid, under the shallow water and Boussinesq approximations. In the vertical momentum equation, the vertical accelerations are assumed to be negligible and are neglected; this leads to the hydrostatic pressure equation.

3.2 Existing Conditions

3.2.1 Model Grid

The numerical model grid is shown in Figure 3-1. The model extent is approximately 9,700 m alongshore and 2,500 m cross-shore. Grid size is variable throughout the domain. The largest grid cells are located near the open boundaries with dimensions on the order of 180 m by 270 m, while the smallest grid cells are located at the existing harbor with a resolution of approximately 25 m by 25 m. The offshore boundary is located at a depth of roughly 650 m.

The vertical grid consists of layers bounded by two sigma planes, which are not strictly horizontal but follow the bottom topography and the free surface. Because the σ-grid is boundary fitted both to the bottom and to the moving free surface, a smooth representation of the topography is obtained. The number of layers over the entire horizontal computational area is constant, irrespective of the local water depth. A total of 8 layers are used in the model.

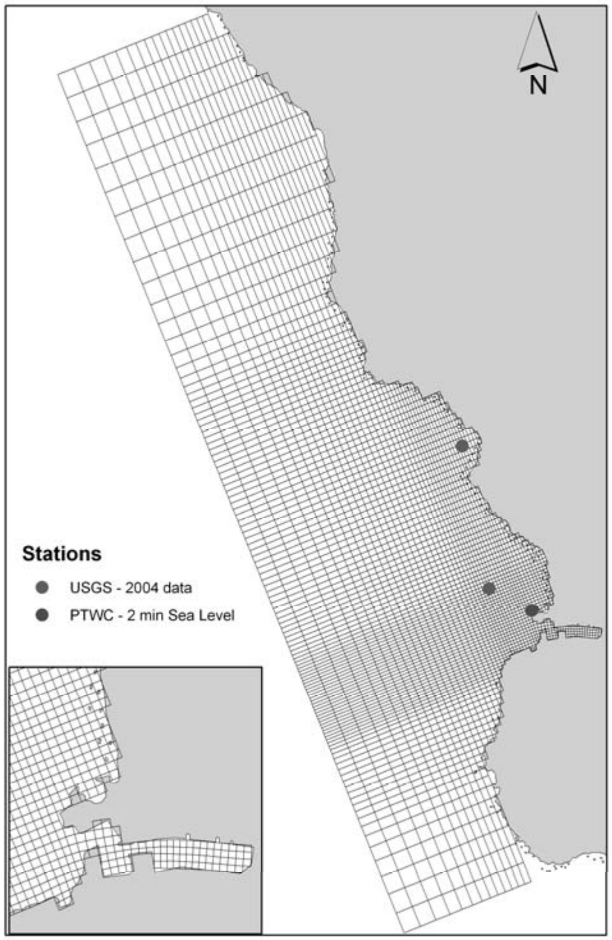

Figure 3-1: Model grid and location of available data

3.2.2 Model Bathymetry

The model bathymetry is presented in Figure 3-2. The near-shore bathymetry was created using data collected by the SHOALS (Scanning Hydrographic Operational Airborne Lidar Survey) system to a depth of -30 m MSL. At the harbor the bathymetry was created using the available navigation chart. Offshore areas were constructed from surveys collected by the National Oceanographic Service (NOS) of NOAA and available via their GEODAS system.

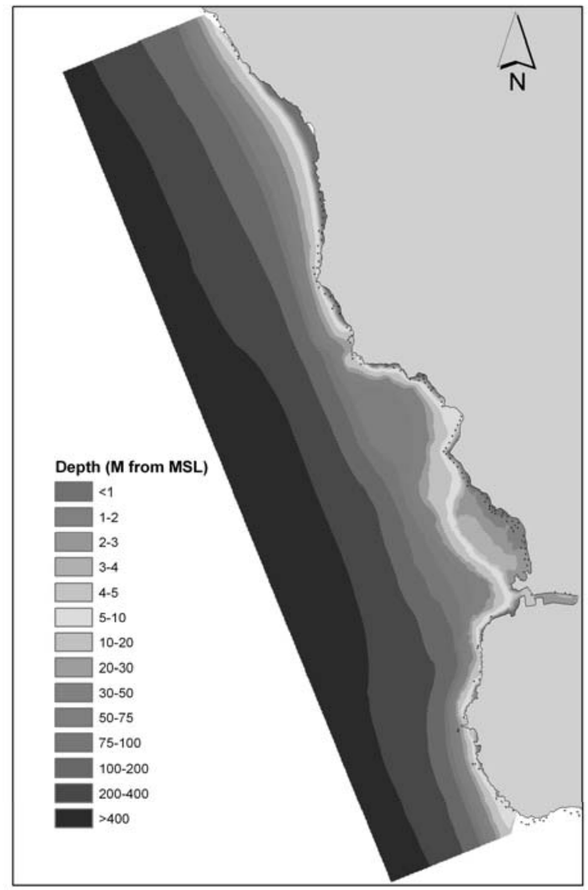

Figure 3-2: Model bathymetry

3.2.3 Boundary Conditions

The model was constructed with open-ocean forcing at its offshore boundaries. Detailed water level measurements along this boundary are not available. Instead, tidal constituents derived from available data can be used to construct a time series of water elevations. Water level measurements along the west coast of Hawaii are available at 4 stations (see Figure 3-3). Three of these gauges, Mahukona, Honokohau and Milolli are maintained by the Pacific Tsunami Warning Center (PTWC), and the gauge at Kawaihae is maintained by the National Ocean Service (NOS). Data at Mahukona and Milolli are on a 5 second interval and only available until 2004. Data at Honokohau are available on a 2-minute interval and available to the present. The detailed location of this station is presented in Figure 3-1. Data at Kawaihae are available on a 6-minute interval and are available to the present.

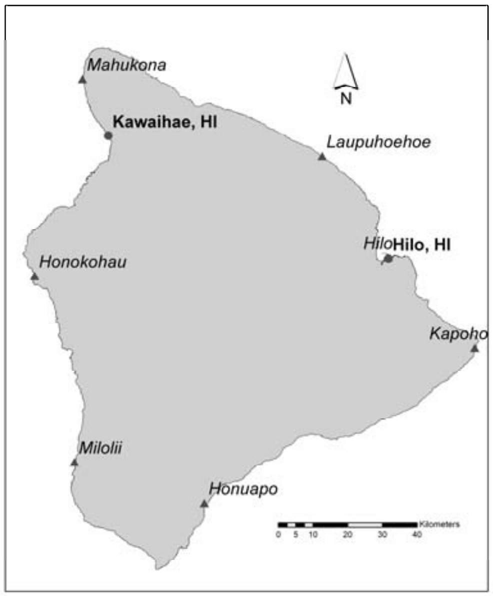

Figure 3-3: Available water elevation stations in Hawaii.

The two stations closest to the project location also measured more recent data. These stations, Kawaihae and Honokohau, were used to define the model boundary conditions. The distance between these two stations is approximately 50 km. One year of data was used to compute the 8 main tidal constituents at these two stations. These 8 tidal constituents are described in Table 3-1.

Table 3-1: Description of Tidal Harmonic Constituents

Harmonic Constituent	Speed (deg/hr)	Period (hr)	Description
O1	13.943	25.819	Principal lunar diurnal constituent
K1	15.041	23.935	Solar-lunar constituent
Q1	13.398	26.870	Larger lunar elliptic diurnal constituent
P1	14.959	24.066	Solar diurnal constituent
M2	28.984	12.421	Principal lunar tide
S2	30	12.000	Principal solar tide
N2	29.439	12.659	Monthly variation in lunar distance

The amplitude and phase of the 8 tidal constituents were extracted using the MATLAB toolbox "T-tide" (Pawlowicz *et al*., 2002). Values are presented in Table 3-2.

Table 3-2: Extracted Harmonic Constituents at Kawaihae and Honokohau

	Kawaihae (NOS)		Honokohau (PTWC)	
Harmonic Constituent	Amp (m)	Phase (deg)	Amp (m)	Phase (deg)
M2	0.200	58.2	0.196	45.0
N2	0.036	49.6	0.032	38.7
K2	0.020	55.6	0.016	36.2
S2	0.065	64.1	0.074	52.1
K1	0.158	226.3	0.154	219.4
P1	0.049	223.7	0.038	216.0
O1	0.089	214.0	0.083	209.8
Q1	0.013	204.3	0.012	198.5

The hydrodynamic model was forced by water levels at the offshore boundary and water level gradients at the lateral boundaries (north and south). These gradients were interpolated from the two stations presented in Table 3-2. Water levels at the offshore boundary consist of tidal predictions from interpolated tidal harmonic constituents of the two available stations. The phase difference for each constituent between these two stations was also computed. These stations are approximately 50 km apart while the model lateral boundaries are separated by 10 km; therefore a fifth of the phase difference was applied between the north and south model boundaries.

Salinity concentration and water temperature at the offshore boundary were selected as 34 ppt and 25 ºC respectively. These values are constant with depth and are based on the farthest offshore measured values presented in Ziemann (2006)

3.2.4 *Typical Conditions Assumptions*

The conditions modeled within the hydrodynamic and subsequently the water quality model are meant to represent typical conditions. The hydrodynamic model extents are not sufficient to simulate extreme events that would introduce significant surge or result in higher velocities such as tropical cyclones or tsunamis. It also does not include local wave effects or oceanic currents. The hydrodynamic conditions represented by the model include tidal elevations and include groundwater inflow, represented as point sources. The hydrodynamic model also incorporates typical heat flux conditions including relative humidity, air temperature, solar radiation, and percent cloud cover. Evaporation and conduction were also included in the computation. Each value entered into the heat flux model was taken as a typical day. One month of hourly solar radiation data was obtained from the Hilo weather station (Figure 3-4). A full year of daily atmospheric data was obtained from the Western Regional Climate Center. These data consisted of daily minimums and maximums (Figure 3-5 and Figure 3-6). The average minimum and maximum for the year were computed and used to extrapolate a daily time series of relative humidity and air temperature values. The extrapolated time series for these values are shown in Figure 3-7 and Figure 3-8 respectively. An average value of 250 J/m^2/s was computed as the model input for solar radiation, and daily variations were computed by the model.

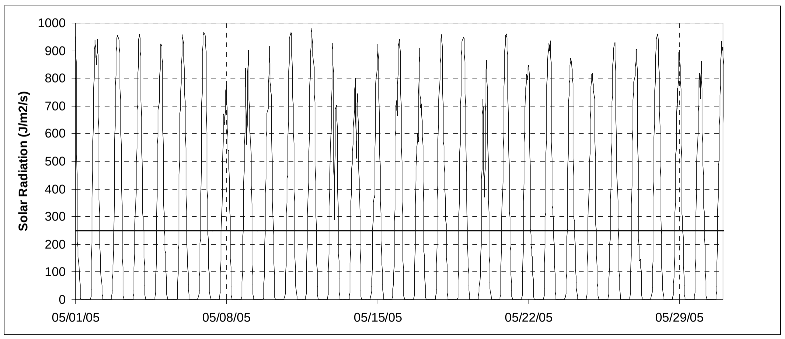

Figure 3-4: Solar Radiation

Figure 3-5: Maximum (red) and minimum (blue) air temperature

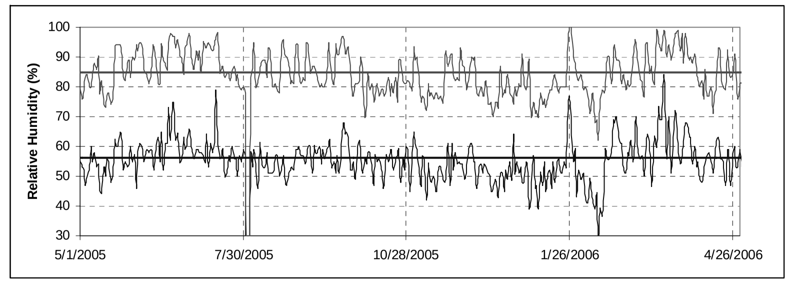

Figure 3-6: Maximum (red) and minimum (blue) relative humidity

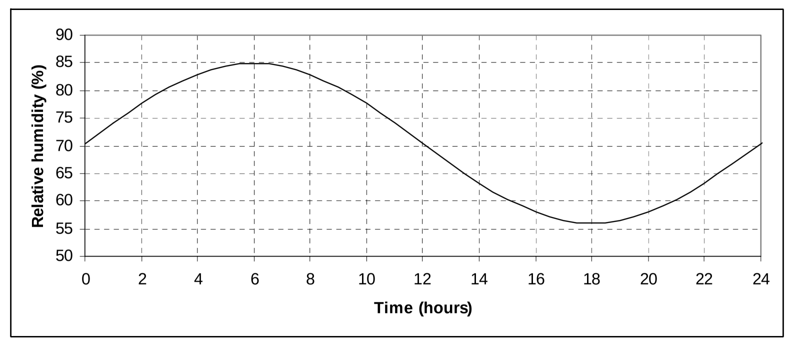

Figure 3-7: Average daily relative humidity

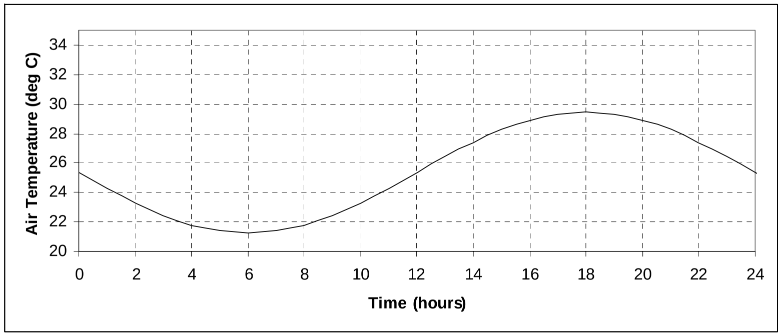

Figure 3-8: Average daily air temperature

3.2.5 Water Level Calibration

Model calibration was performed for May 2004 in order to coincide with the data collection period of Storlazzi and Presto (2005). The location of the stations for this study period is shown in Figure 3-1. Hourly values at the south station were provided by the National Park Service (NPS) covering the period 4/30/2004 to 10/30/2004. The data included depth, current speed and direction at 3 and 12 meters, significant wave height, wave period, temperature and salinity. Two-minute water level data from PTWC at Honokohau is also available for the same period.

Since tidal predictions were used to force the model at the open boundaries, the differences between measured and simulated water levels, are mainly due to differences between tidal predictions and water levels. As mentioned in previous sections, only 8 constituents were used to create the tidal open boundaries. The correlation coefficient between the PTWC water level data and the tidal predictions at this location is 0.93, and the Root Mean Square (RMS) error is 7 cm. These differences are the same as those obtained at the measurement location by comparing the measured and simulated water levels. Figure 3-9 shows time series of water levels from PTWC, USGS south station and simulated during May 2004.

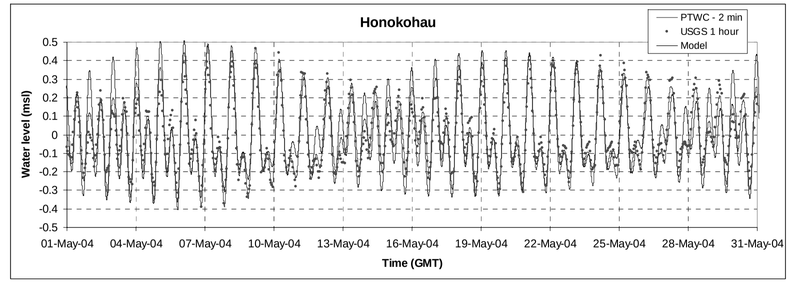

Figure 3-9: Water level data and modeled at Honokohau during May 2004

3.2.6 Velocity Calibration

Figure 3-10 presents simulated tidal flow fields at surface and bottom during peak ebb and flood on the 16th of May 2004. It can be observed from the figure that flood tidal currents are generally higher than ebb tidal currents, which is probably associated to the mixed tides of this area. In addition, the current reversal offshore is not present on the shallow area of Honokohau Bay, where the surface ebb tidal current is also moving north. The maximum tidal currents at the surface near the site of the USGS south measurement (see Figure 3-1) are in the order of 0.15-0.2 m/s, with an average value in the order of 0.07 m/s (Storlazzi and Presto, 2005 reported values of 0.09±0.07 m/s 3 m below the surface). In addition, the simulated primary flow direction at the USGS south location is approximately parallel to the shore, as presented in Storlazzi and Presto (2005). For example, the semi major axis of the largest constituent (M2) of the simulated tidal currents at the south location is approximately 0.05 m/s and is approximately parallel to the shore (varies between 25 and 15 degrees counterclockwise from North at surface and bottom).

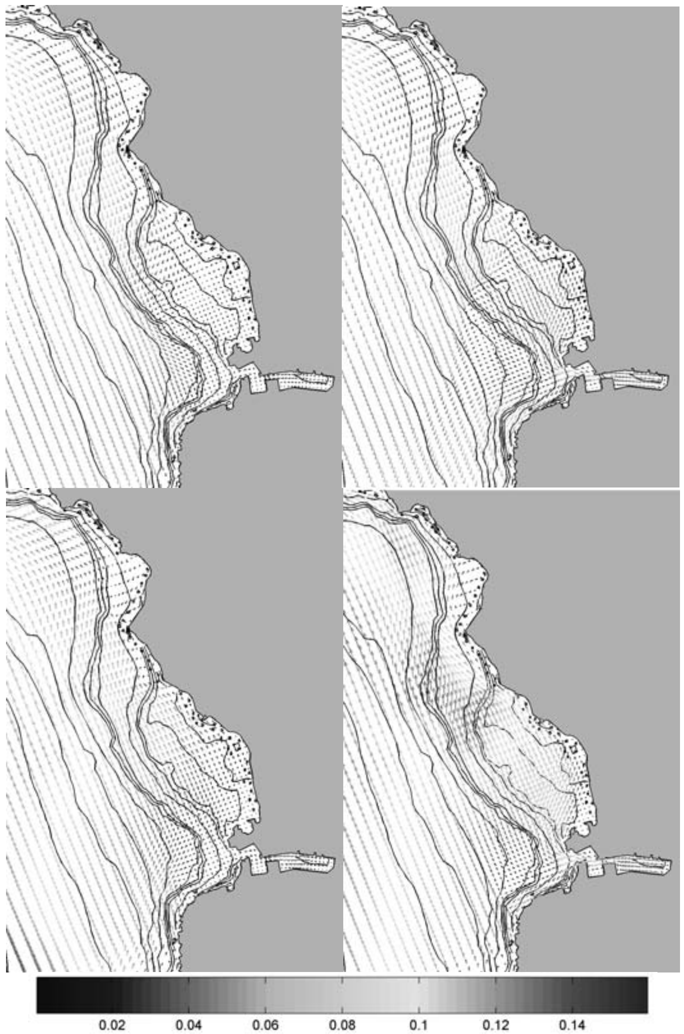

Figure 3-10: Simulated flow patterns during ebb tide (top) and flood tide (bottom) at bottom (left) and surface (right) layers on the 16th of May, 2004 (velocities in m/s)

The effect of the salinity gradients at the harbor are also observed in the currents. The surface current at the harbor entrance is always moving seaward while the current at the bottom is always moving landward. This is also observed in Figure 3-11 which presents the simulated velocity profiles at the harbor's entrance under peak ebb and peak flood conditions. It can be concluded from Figure 3-11 that the vertical distribution of velocities at the entrance shows high velocities in the surface moving seaward, and velocities entering the harbor in the bottom layers, as a consequence of the density stratification created by the brackish groundwater inflow into the harbor. Vertical distribution (with the position of zero velocity at a depth between 1.5 and 2.5 m) and magnitudes of the velocities are very similar to those described in Gallagher (1980) and the ADCP measurements presented in the Oceanit Laboratories (2006).

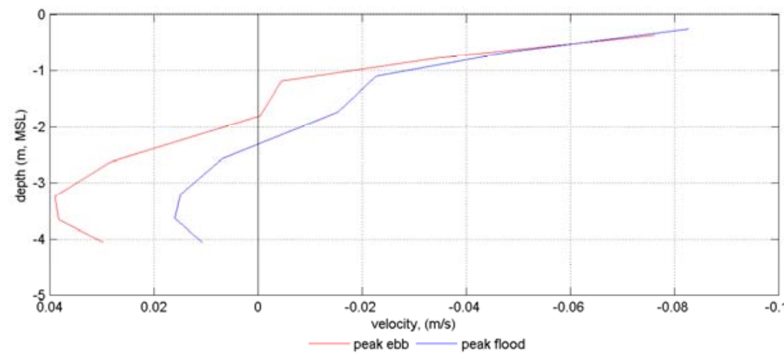

Figure 3-11: Velocity profile at harbor entrance

Figure 3-12 shows location of all cross-section and depth profiles extracted from the model and that are shown throughout the report. The cross-section of the existing harbor (Transect EH) is shown in red, while the cross-section of the future Marina is shown in purple (Transect NM). Figure 3-11 is taken from the harbor mouth point also shown in Figure 3-12.

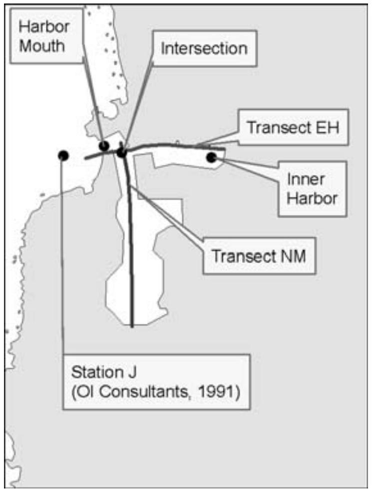

Figure 3-12: Locations of cross-sections and depth-profiles

3.2.7 Ground Water and Salinity/Temperature Calibration

The regional groundwater flow system with particular interest in the Kaloko-Honokohau National Historical Park area is described with detail by Oki *et al*. (1999). The study indicates that the groundwater flow system in the vicinity of the Park is part of the regional brackish-water transition zone. Oki *et al*. (1999) also assume that the main freshwater component of brackish water flowing through the Park is from subsurface flow originating from inland areas east of the Park. Brackish ground water forms by seaward flowing freshwater mixing with saltwater. The area of extensive mixing with saltwater extends upgradient from the Park. The brackish groundwater body overlies saltwater and extends to an estimated depth of about 50 to 100 feet at the inland boundary of the Park where the ground water is freshest. The study also indicates that because of the highly permeable offshore volcanic-rock outcrops, saltwater can easily enter the aquifer, and that a saltwater-circulation system exists beneath the freshwater lens. Saltwater flows landward in the deeper parts of the aquifer, rises, and then mixes with seaward-flowing freshwater. This mixing creates a brackish-water transition zone. In areas near the coast where saltwater mixes thoroughly with seaward-flowing freshwater, a freshwater lens may not form and brackish water may exist immediately below the water table. This is the case at the location of the existing harbor, and based on the available measurements it appears that the harbor was built in a location intercepting the layer of brackish water flowing seaward. A schematic view of the groundwater flow system is presented in Figure 3-13, which was taken from (Oki *et al*., 1999).

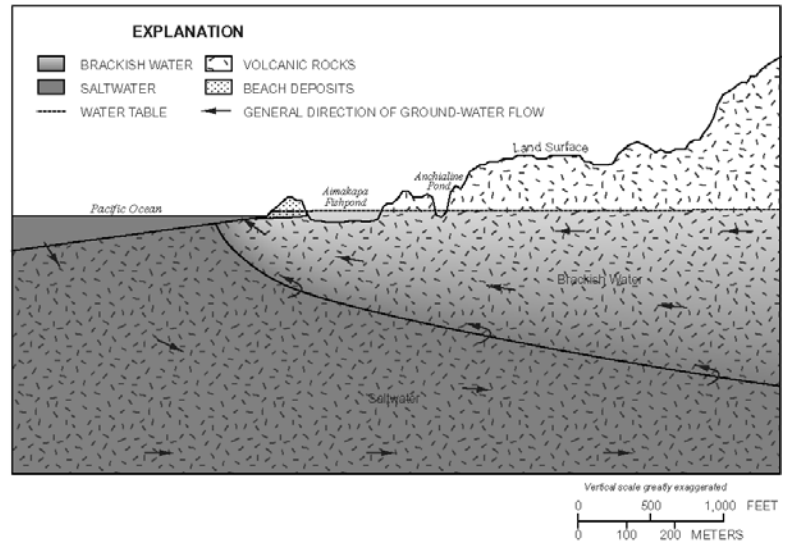

Figure 3-13: Schematic cross-section of the groundwater flow system in Kaloko-Honokohau National Historical Park, Island of Hawaii (Source: Oki *et al*., 1999)

The groundwater inflow into Honokohau Harbor has been reported in a number of studies as both freshwater and brackish water. The circulation within Honokohau Harbor is controlled by the influx of brackish groundwater, and determining the appropriate value for this source is imperative. Salinity and temperature distribution in the Harbor are controlled by both advection and dispersion effects. The advection component is dominated by the circulation in the harbor, which is a combination of tidal currents and currents generated by the two layer system created by the groundwater inflow. The dispersion part represents the scattering of a substance (salinity or temperature in this case) by effects of shear and diffusion. Therefore, it is necessary to estimate the rate of the brackish groundwater inflow into the harbor and the dispersion coefficient of the groundwater to correctly simulate, with the numerical model, the conditions at the Harbor.

Review of Available Information

This section summarizes the information obtained from some of the available studies regarding three different variables:

- Groundwater inflow into the harbor,
- Salinity and temperature profiles, and
- Flushing time.

Groundwater inflow

Bienfang (1980) described the water quality characteristics of Honokohau Harbor before the harbor expansion. The study mentions that the continual groundwater influx into the harbor, in the order of 1.5-2 million gallons of fresh water per day, produces harbor flushing rates six to ten times those calculated by tidal flushing alone. Bienfang (1980) based his estimate on the results from Cox *et al*. (1969) who said that the groundwater inflow in the Honokohau area is comparatively low because of the small recharge resulting from low rainfall and high evapotranspiration conditions of the area. Cox *et al*. (1969) estimated groundwater discharge in the Honokohau shoreline area to be a few millions gallons of freshwater per day per mile. Although in Bienfang (1980) it was mentioned that excavation of the harbor has displaced the natural discharge points in the immediate area landward, and that this displacement may also have caused enhanced discharge in this area, his oceanographic analysis still estimates the groundwater discharge into the harbor to be in the same order of the one suggested in Cox *et al.* (1969) along the shoreline.

A study also presented in 1980 by Gallagher, in same journal issue and under the same funding as Bienfang (1980), focused on the physical structure and circulation in the harbor. Using an extensive measurement campaign, this study concluded that the springs in the harbor were contributing on the order of 70 m^3/min (~27 mgd) of brackish water with an average salinity of 25 ppt during both ebb and flood phases of the tide. Gallagher (1980) also indicates that the bottom spring inflow rate is greater than the tidal exchange rate in the harbor, which is the cause of the pronounced layering and vigorous circulation. In addition, this study concluded that the flushing time of the harbor is in the order of 12-13 hours due to the existence of the strong flow of brackish water from the springs.

A recent study (Glenn, 2006) used infrared images and natural tracers to estimate the coastal groundwater discharges. Similar values were obtained from 3 coastal sites while at Honokohau Harbor the fluxes were estimated to be in the order of 20 times higher. Glenn (2006) indicates that this is likely the result of constructing the harbor at a level that intercepted the water table, resulting in "anthropogenically enhanced" flow. This study did not provide an estimate of the volume of brackish water flowing into the existing Harbor.

Salinity and Temperature Profiles

Salinity profiles from different studies indicate that under different tide conditions, the 29 ppt contour extends to a distance between 400 and 500 meters from the back Harbor wall. During the 1991 study by OI Consultants, this is observed for both high and low tide. Figure 3-14 shows the period where salinity and temperature cross sections were measured at Honokohau Harbor, (red shows the salinity and temperature cross sections at High Tide and green those at Low Tide). The salinity profiles are presented in Figure 3-15 and Figure 3-16.

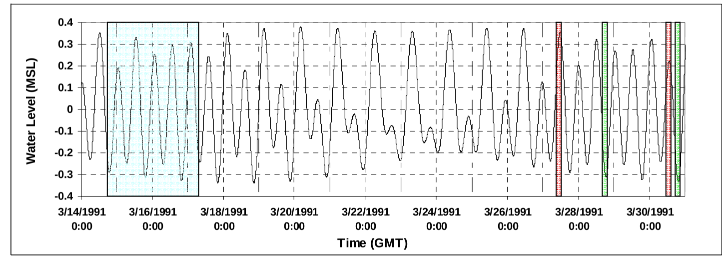

Figure 3-14: Studies in 1991

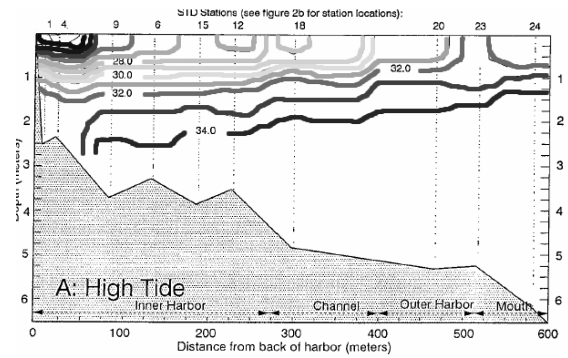

Figure 3-15: Salinity contours at high tide –27 March 1991, from OI Consultants, 1991

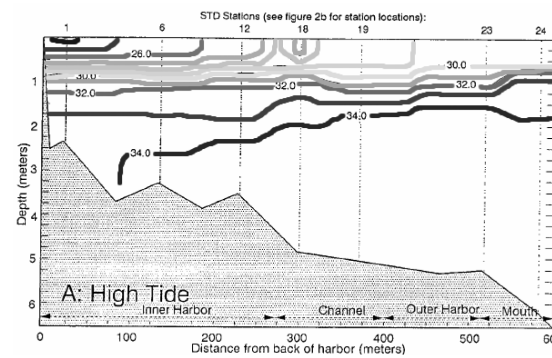

Figure 3-16: Salinity contours at high tide –30 March 1991, from OI Consultants, 1991.

A more recent report presented by University of Hawaii (Glenn, 2006) (see Figure 3-17) also shows that the 29 ppt contour at the surface extends to approximately 500 meters from the back Harbor wall. Finally, recent data collection by Oceanit Laboratories between April 3 and 13, 2006 (Ziemann, 2006) showed a surface salinity of 28.9 ppt at the Harbor entrance, approximately at 500 meters from the back Harbor wall.

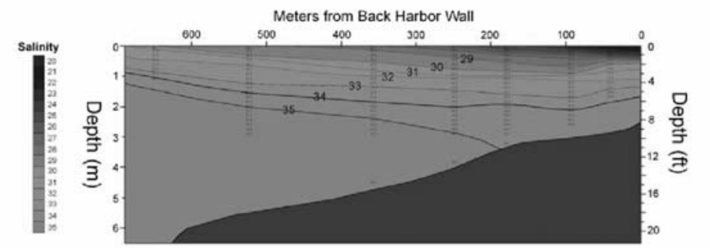

Figure 3-17 : Salinity distribution in February 2006 from University of Hawaii, C. Glenn, November 2006

The consistency of available historical and recent measurements indicate a very stable salinity distribution in the harbor which is probably associated more to the location of the harbor in relation to the density gradients in the groundwater system than to the head differences in the aquifer.

Flushing Time

After the harbor expansion, OI Consultants subcontracted Noda and Associates, Inc. to perform a dye study in order to assess the flushing time of the Harbor. This study was conducted over a 4 day period in March, 1991. Figure 3-14 shows in blue the period when the dye study in the Harbor was carried out (OI Consultants, 1991) together with the water elevation in the Harbor. Rhodameine WT dye in a 20% aqueous solution (about 5 gallons) was injected throughout the Harbor during a five hour period (flooding tide) ending at 13:00 on March 14, 1991. The deployment of the dye was designed such that the dye would be vertically and spatially uniform throughout the Harbor. Measurements were taken at 8:00 on March 15, 16, 17, and 18 in order to assess the concentration throughout the Harbor. The method, described in one of the following sections, was used to determine the residence time at five stations throughout the Harbor.

The analysis was first applied to tidal-only flow exchange with the ocean waters (OI Consultants 1991). The tidal flushing time was computed to be approximately 3.2 days. Measured results from the five stations within the Harbor show much shorter residence times, with stations in the inner part of the Harbor having average residence times of 0.4 days. It was also shown that the residence time at all stations was fairly depth independent indicating that the mixing of the tracer dye and "fresh" water was fairly consistent throughout the Harbor. The representative flushing time for the entire Harbor was the average of all five stations and was 0.42 days, which is 7.6 times faster than the tidal flushing time.

OI Consultants (1991) also noted that the tidal prism is about 16.5 million gallons per day (mgd) and that using the groundwater intrusion calculated by Bienfang (1980) of 1.5 to 2 mgd represents only about 9% to 12% of the flushing volume. This is counterintuitive to the results presented, and indicates that the 1.5 to 2 mgd of groundwater intrusion refers to fresh groundwater and not the total volume of brackish groundwater that enters the Harbor, which could be a significantly larger amount. Gallagher (1980) reported intrusion rates within the Harbor of 70 m^3/min or 27 mgd of brackish groundwater, which is equivalent to 9.5 mgd of pure fresh water. Gallagher (1980) found using a numerical model that the residence time of the Harbor was on the order of 12-13 hours or 0.5-0.54 days.

<u>*Calibration data*</u>

Based on the available information presented in the previous section, brackish groundwater inflow and the dispersion coefficient in the numerical model were calibrated to meet the following observations:

- Most of the data indicates that the 29 ppt contour at the surface extends to a distance between 400-500 m from the Harbor back wall.
- The depth of the 33 ppt contour is very stable in most of the data sets. Gallagher (1980) used this contour to define an arbitrary boundary between the top and bottom layers inside the Harbor.
- Flushing time should vary between the values reported by OI Consultants (1991), 0.42 days or 10 hours, and those reported by Gallagher (1980), 0.5-0.54 days or 12-13 hours.
- Flushing time is homogeneous with depth as reported by OI Consultants (1991).

<u>*Brackish Groundwater Inflow and Dispersion Coefficient Calibration*</u>

The selected calibration period coincides with the time when OI Consultants (1991) performed the dye study. For each combination of brackish groundwater discharge and dispersion coefficients, the transport of a conservative tracer was carried out using a coupled hydrodynamic and water quality model. The model was seeded with a conservative tracer up to the mouth of the harbor with an initial concentration of 1 g/m^3 at each vertical layer. Outside of the harbor, the concentration was set with an initial value of 0 g/m^3. Conservative tracer model simulations were started at the point of last release of the Rhodameine dye at 13:00 March 14, 1991.

To compare model results to the analysis presented in the study conducted by OI Consultants, Inc., the computation of a flushing time constant, *T*, was used to represent the residence time in the harbor. The same method of computing the residence time used by OI Consultants (1991) was applied in this study. The method is summarized in the following paragraphs.

The concentration of a constituent within an enclosed body of water like a harbor which is dominated by tidal effects can be described by

$$C = C_0 e^{-t/T}$$

Where C_0 is the initial concentration and C is the concentration of the constituent at time t. T is considered to be the flushing time constant or the residence time of the particle in units of time. This approach is often referred to as the "e-folding" approach. The residence time, T, can be considered to be the time required for reduction of a conservative tracer concentration to $1/e$ or

36.8% of its initial value, or a reduction of 63.2%. Mathematically, assuming an exponential distribution of times for individual water particles to reach the ocean, when the concentration of particles reaches 1/e, it represents the average time of all particles to reach the ocean.

If the natural logarithm of the above equation is written as

$$\ln(C) = \ln(C_0) - t/T$$

then it is seen that the natural logarithm of the concentration of a tracer is a linear function of the time with a slope of -1/*T*. In this way, the residence time can be estimated without knowing the initial concentration.

Several combinations of brackish groundwater discharge and dispersion coefficients were simulated. These simulations used a combination of values of brackish groundwater discharge between 8 and 55 mgd and a dispersion coefficient between 0.1 and 1.0 m^2/s. The salinity concentration of the brackish groundwater discharge was selected to be 22 ppt and the temperature 20 ºC, which is in the order of the values observed near the back wall of the existing Harbor.

The following conclusions were obtained from the analysis of the model results

- Groundwater discharge controls the flushing rate of the surface layer. For example, when the inflow rate was kept at a low value such as 4 to 8 mgd, the flushing rate of the surface layer varies between one and more than two days depending of the dispersion coefficient applied.
- The observed vertical salinity distribution in the harbor, with the 29 ppt contour at the surface reaching a distance of 400-500 m from the back wall is only obtained for brackish groundwater discharges larger than 20-25 mgd.
- The field study conducted by OI Consultants (1991) shows flushing time constants within the Harbor to be fairly uniform with depth. In order to achieve the mixing of the conservative tracer throughout the depth layers, a dispersion coefficient closer to the upper limit of the selected range (horizontal dispersion coefficients were varied between 0.1 m^2/s and 1 m^2/s) was needed. It was found that using dispersion coefficients at the upper limit promoted too much mixing, impacting the top layer thickness throughout the Harbor, independently of the flow rate used. For example a flushing time in the order of 12 hours could be obtained for a groundwater discharge as low as 20 mgd but for a dispersion coefficient of 1 m^2/s, which produces excessive vertical mixing creating a top layer (salinity values smaller than 33 ppt) thicker than observed. On the other hand, using dispersion coefficients at the lower limit caused little to no mixing of the conservative tracer in the lower layers over the three day period.
- The best results were obtained for a groundwater discharge of 30 mgd and a dispersion coefficient of 0.7 m^2/s. Flushing time results show low variation with depth (STD about 0.1 days) and a mean flushing time of 0.53 days, which is about 12-13 hours as reported by Gallagher (1980). Increasing the dispersion coefficient to 0.8 m^2/s produced a smaller flushing time but also a thicker than observed top layer. Increasing the groundwater discharge or decreasing the dispersion coefficient moved the 29 ppt contour at the surface too far away from the harbor back wall.

The flushing time results calculated from the model simulated concentration for a groundwater discharge of 30 mgd and 0.7 m^2/s are presented in Table 3-3 at the same five stations reported by OI Consultants (1991) and at the top, middle and bottom of the water column. The full results of the calibration are displayed in Appendix B.

The groundwater discharge is meant only to represent a typical value. While it has been shown (Waimea Water Services, 2006) that the groundwater discharge into Honokohau Harbor varies with tides and seasonal rainfall events, this was not represented by the model.

Table 3-3: Flushing time (days) from the calibrated model 30 mgd and 0.7 m^2/s

	Station 1	Station 2	Station 3	Station 4	Station 5
Top	0.53	0.53	0.53	0.53	0.54
Middle	0.53	0.54	0.54	0.53	0.53
Bottom	0.52	0.52	0.52	0.49	0.52

In addition Figure 3-18 presents the salinity cross section across the harbor obtained from the calibrated model.

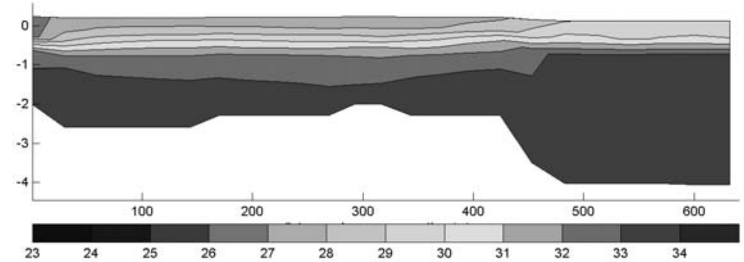

Figure 3-18: Simulated salinity contours (ppt) along Transect EH (Figure 3-12) at high tide –27 March 1991 for 30 mgd and 0.7 m^2/s

3.3 Future Conditions

The existing conditions model presented in the previous section was modified to include the Kona Kai Ola Marina. The future conditions model setup also considers possible brackish groundwater inflows mainly at the eastern side of the new basin. Additional inflows from the exhibit area of the development were included in the model as point sources. The uncertainty of the brackish groundwater inflow into the new Marina prompted a series of tests that examined a range of possible scenarios including the worst expected case. The purpose of this is to enhance the knowledge of the mechanisms controlling the hydrodynamic conditions of the new two-basin system, as well as to provide a range of possible conditions of the system.

The future conditions model was implemented following the same principles used for the existing conditions model described in the previous section. Offshore boundary conditions and bathymetry were kept the same. Conditions in the existing Harbor, including the brackish groundwater inflow were also kept the same. The new marina required additional parameters which are described in detail in the following sections.

3.3.1 Model Grid

The model grid developed in the previous section to simulate the existing conditions at Honokohau Harbor was extended to include the proposed area for the Kona Kai Ola Marina. Figure 3-19 shows the extent of the grid expansion. The offshore sections of the grid remained entirely unchanged. The grid extension does not encompass the area designated for the exhibit areas. These areas are included in the model as point sources of inflow.

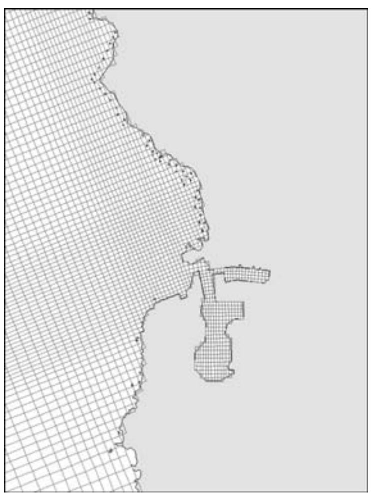

Figure 3-19: Model Grid Including the Kona Kai Ola Marina

3.3.2 Model Bathymetry

The same offshore and existing Harbor bathymetry used in the existing conditions model was also used in the future conditions model. The Kona Kai Ola Marina bathymetry and layout was built following the design plans included in the EIS. Figure 3-20 presents the future conditions model bathymetry.

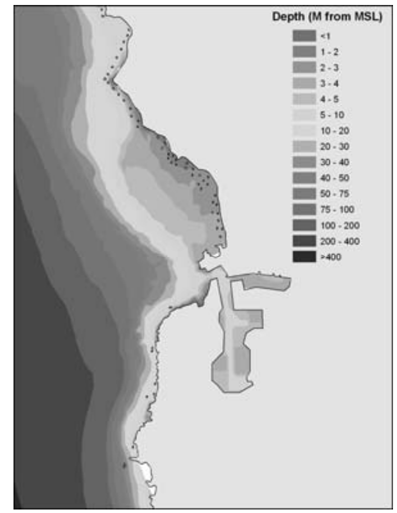

Figure 3-20: Model bathymetry including the Kona Kai Ola Marina

3.3.3 Model Boundaries and Additional Inflow into Kona Kai Ola Marina

Conditions at the offshore boundaries are the same described and applied in the existing conditions model. It is assumed that brackish groundwater discharge into the existing Harbor will remain the same after the construction of the new Marina. Additional inflows into the new Marina consist of discharges generated by the exhibit area and brackish groundwater inflow through the porous volcanic ground, mainly through the east wall of the new Marina. The exact value of this additional inflow is not known. In order to compensate for the unknown inflow, the model solution was bracketed between no flow conditions and twice the observed value under existing conditions (in addition to the present inflow). No flow conditions were analyzed in order to look at a control scenario which is suspected to be the worst case scenario in terms of flushing. A value of 30 mgd would represent persistence of the current conditions, since that it the value present in the existing marina and therefore it is considered a good starting point for analysis. Values of 15 mgd and 60 mgd represent a factor of two increase and decrease of inflow from the starting point. The simulated conditions are summarized in Table 3-4. A complete groundwater study would be needed in order to estimate with confidence the amount of brackish groundwater flow that would enter the new Marina. Other possible inflows into the new Marina such as the one associated with the SWAC air-conditioning system have not been considered in this study.

Table 3-4: Summary of tests used for description of future hydrodynamic conditions at the new Marina

Case 1	Brackish discharge = 0 mgd Exhibit discharge = 0 mgd
Case 2	Brackish discharge = 15 mgd Exhibit discharge = 0 mgd
Case 3	Brackish discharge = 30 mgd Exhibit discharge = 0 mgd
Case 4	Brackish discharge = 60 mgd Exhibit discharge = 0 mgd
Case 5	Brackish discharge = 0 mgd Exhibit discharge = 75 mgd
Case 6	Brackish discharge = 15 mgd Exhibit discharge = 75 mgd
Case 7	Brackish discharge = 30 mgd Exhibit discharge = 75 mgd
Case 8	Brackish discharge = 60 mgd Exhibit discharge = 75 mgd

Part of the flow that enters the new Marina from the exhibition area flows through three waterfalls and the rest is piped into the new Marina. This water is originally pumped from offshore at a depth of approximately 100 m with a flow rate of 75 mgd. The intake depth was selected to minimize the nutrient loads of the water (pers. comm. ClowardH2O, 2007). The water is then pumped to the exhibition area. The water is at an oceanic salinity (34 ppt) and has a temperature when withdrawn of approximately 3 ºC less than the surface water. Assuming that the pumping and subsequent movement through the exhibition area will serve to increase the temperature approximately 1 degree, it is assumed that the inflows to the new harbor are approximately at a temperature of 23 ºC (all assumptions and calculations with relation to the exhibit water were obtained from pers. comm. ClowardH2O, 2007). The water is expected to have an approximate 4 hour residence time within the exhibition area (pers. comm. ClowardH2O, 2007)

Brackish groundwater flowing into the new Marina is assumed to enter the basin only through the eastern side. The brackish groundwater inflow (15, 30, or 60 mgd) is equally distributed along all the grid points on that the eastern side of the Marina. In spite of the uncertainty associated with this assumption, mainly because some areas of the Harbor extension cut into the groundwater table further inland than others, it is considered to be a reasonable range of values to represent the system.

3.3.4 Flushing Under Future Conditions

The new Marina to be developed as part of the Kona Kai Ola Master Plan is much larger in volume than the existing Harbor. Table 3-5 shows the approximate volume of the existing marina and the new proposed one. Note that the volume of the new Marina does not include the

exhibit area, just the main basin. The Kona Kai Ola Marina is about 5 times larger (by volume) than the existing Harbor, and therefore, the combined system will have a volume six times the existing volume, while the connection to the ocean of the combined system will be maintained as today. The increase in flow into the system with the construction of the new Marina affects the Harbor mouth, primarily due to the increased new outflow from the new Marina. Therefore, the quantity of water that has to leave through the mouth of the combined system will increase from the existing conditions value as the inflows into the new Marina increase.

Table 3-5: Water volumes, from MSL, of existing and proposed marinas

Existing	3,936 m^3
Proposed	19,142 m^3

Flushing time is an important indicator of water quality, as it describes in this particular study the time that certain substance will remain in the harbor. The faster particles, pollutants, or algae flush out of the system, the less build-up there will be within the harbor, and the less chance there will be of major water quality problems like eutrophication and as stated by Ferreira *et al*. (2005), flushing is the primary means of maintaining water quality and biodiversity within a harbor. In previous sections, the flushing time under existing conditions was discussed. This section attempts to quantify the flushing time under a range of potential future conditions after the development of the Kona Kai Ola Marina. Eight cases were analyzed with four brackish groundwater inflow rates. While the exhibit area is a definite feature of the Conceptual Master Plan, its influence on the flushing time of the combined harbor system was assessed independently.

The flushing time was computed using the method outlined for existing conditions. The five stations described under existing conditions were also used in this analysis for the existing Harbor. These points coincide with those from the 1991 OI Consultants dye study. In addition, seven points were selected within the proposed new Marina. Each section of the Harbor was analyzed separately in order to determine the effects of the new Marina on each area. It is important to note however, that the entire system is treated as one system. Water flowing between the existing and new marinas is not considered to be flushed out to the ocean. Only "clean" water (ocean and brackish water inflows) from outside the system can flush the entire system. This is an important factor in the flushing time calculation of the entire system because as it is shown in later sections that there is a significant internal circulation between the two marinas. Rather than show the flushing time at each point, an average value for the entire Harbor section was computed. These average values are displayed in Table 3-6 and Table 3-7 for the existing and new marinas respectively.

Under existing conditions, the average flushing time of the existing Harbor was computed to be 0.53 days or 12.7 hours. After the addition of the new Marina to the system, the new flushing times for the existing Harbor under the highest brackish groundwater flow conditions simulated (60 mgd) increased to 19 hours. In general, for all the simulated cases, the area with the highest flushing times is the one at the back end of the new Marina. These flushing times were higher than 2 days in the case of no brackish groundwater discharge.

Table 3-6: Flushing times for the existing Harbor in days

Case	No Exhibit Flow	Exhibit Flow Included
Discharge 0 mgd	1.38	1.49
Discharge 15 mgd	1.11	1.10
Discharge 30 mgd	0.98	0.94
Discharge 60 mgd	0.86	0.83

Table 3-7: Flushing times for the Kona Kai Ola Marina in days

Case	No Exhibit Flow	Exhibit Flow Included
Discharge 0 mgd	2.39	1.72
Discharge 15 mgd	1.76	1.32
Discharge 30 mgd	1.44	1.09
Discharge 60 mgd	0.97	0.91

The simulated cases were designed to provide a range of solutions that span the possible post-expansion conditions. Since the flushing time decreases as the brackish groundwater inflow into the new Marina increases, the worst case scenario will be the one where the brackish groundwater inflow to the new marina is 0 mgd. The different brackish groundwater inflows simulated can be used to define an array of possible solutions, since the exact volume of groundwater is not known. A complete groundwater investigation would be needed to asses the quantity of brackish water entering the Harbor, although this value will not be known with certainty until the project construction is completed. However, from this analysis, it is seen that after construction of the new Marina, even with relatively high brackish groundwater inflow conditions (60 mgd in the new Marina and 30 mgd in the existing Harbor), it is not expected that the flushing time for the existing Harbor will decrease or even remain the same as under the current conditions. The results demonstrate that the flushing time is not only dependent on the volume of water entering the harbor system but also on the density driven circulation patterns associated with that addition. Given the new Marina basin is approximately five times the volume of the existing Harbor, even using the most optimistic scenario (brackish discharge of 60 mgd and a 75 mgd exhibit outflow, with a total = 5 times the 30 mgd used as inflow to the existing Harbor), the flushing time of the new Marina is 0.97 days which is significantly higher than the 0.53 days experienced under the current conditions.

It is also evident that while the 75 mgd of saline inflow coming from the exhibits does have a positive effect on the flushing time of the new Marina, the results indicate that this saline inflow does not have a significant effect on the existing Harbor's flushing. It is also apparent that smaller quantities of brackish water have more of an effect on the new Marina than does the saline inflow due to the density driven currents that result.

3.3.5 Circulation under Future Conditions

Model results indicate that circulation within the existing Harbor will be modified by the addition of the new Marina. While there is still a well defined two-layer system with a seaward-moving surface layer of brackish water. This surface layer is diverted into the more saline new Marina.

Currents within the new Marina develop into a complicated system. Figure 3-21 through Figure 3-24 show a cross section (Transect NM, Figure 3-12) along the center of the new Marina from south to north (the back wall of the new Marina is located at the left side of the figures) with contours of the velocity in m/s. At lower brackish groundwater inflow rates, the vertical distribution of salinity and velocities in the new Marina consists of three distinct layers (Figure 3-21, Figure 3-23). The top layer is flowing into the harbor with low density water from the existing Harbor. The bottom layer is high salinity oceanic water flowing in from the mouth. The middle layer is flowing out of the new Marina as the higher density oceanic water pushes it up and out of the existing Harbor and new Marina system.

With higher brackish groundwater inflows, the system approaches a two layer system (Figure 3-22 and Figure 3-24) closer to the one observed in the existing Harbor. The surface inflow from the existing Harbor is reduced and does not penetrate into the new Marina as much as observed under lower brackish groundwater inflow conditions.

The impact of the 75 mgd inflow from the exhibits into the new Marina could be estimated by comparing the simulation results without the inflow (Figure 3-21 and Figure 3-22) and those with the inflow (Figure 3-23 and Figure 3-24). Simulation results show that the density driven circulation is reduced when the exhibit inflow is included, since the water in the new Marina becomes more saline.

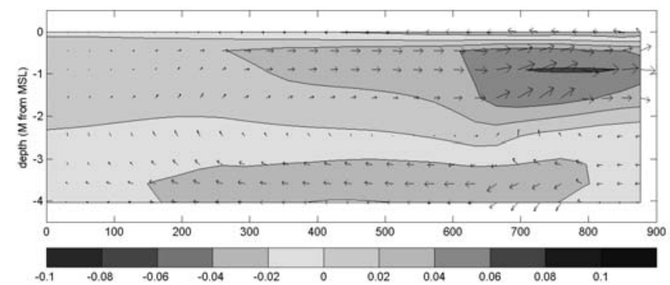

Figure 3-21: Currents at peak flood (m/s) along Transect NM (Brackish discharge of 0 mgd)

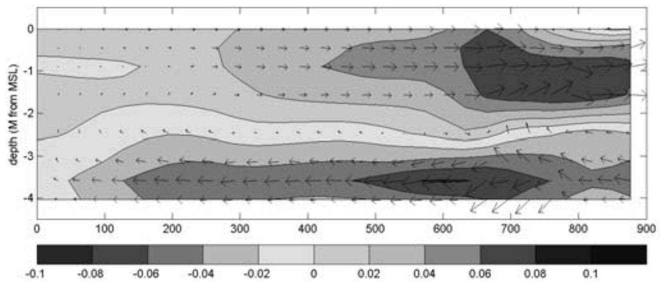

Figure 3-22: Currents at peak flood (m/s) along Transect NM (Brackish discharge of 60 mgd)

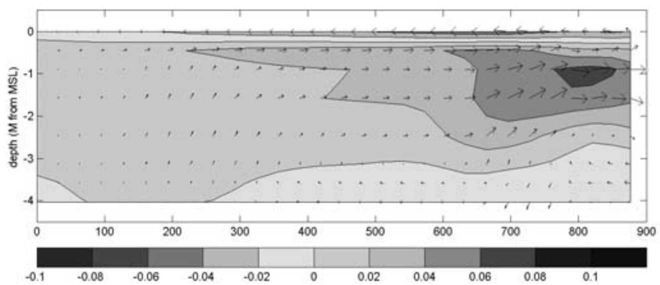

Figure 3-23: Currents at peak flood (m/s) along Transect NM (Brackish discharge of 0 mgd and exhibit discharge of 75 mgd)

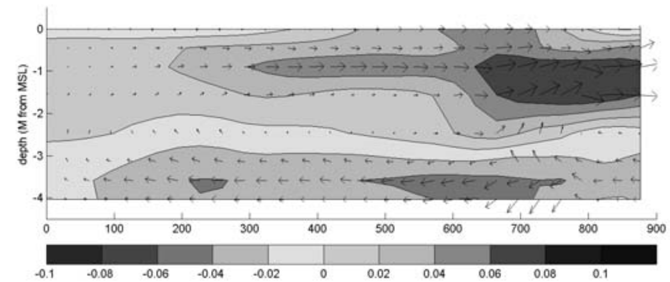

Figure 3-24: Currents at peak flood (m/s) along Transect NM (Brackish discharge of 60 mgd and exhibit discharge of 75 mgd)

Currents at the mouth of the harbor system (harbor mouth, Figure 3-12) are also affected by the increase in flow from the new Marina. Figure 3-25 and Figure 3-26 show how the velocity profile varies at the harbor mouth for flood and ebb tides under different brackish groundwater inflow conditions at the new Marina and also with the additional inflow from the exhibits. The most significant change with respect to existing conditions is observed during ebb flow, when, for the cases with low brackish groundwater inflow into the new Marina, the deep dense water layer moving into the Harbor is canceled. Under these conditions, the water is moving seaward at all depths in the water column, with a significant increase of the surface currents with respect to existing conditions. This effect during ebb flow is more pronounced when the inflow from the exhibit is included in the simulations (see Figure 3-26). During flood flow, the two-layer system observed under existing conditions is maintained, though the magnitude of the velocity at both layers increases.

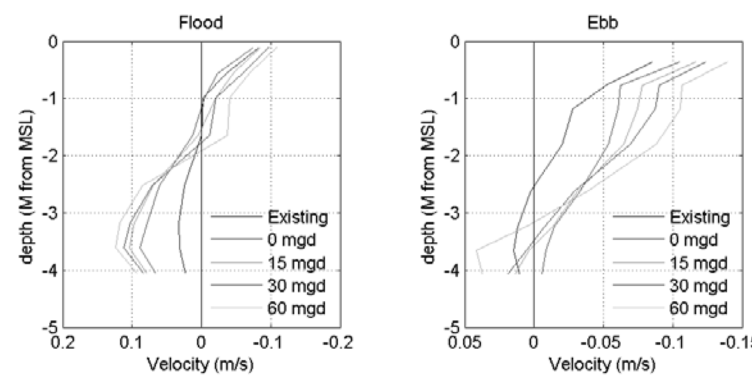

Figure 3-25: Velocity profiles at harbor mouth for 0 mgd exhibit flow

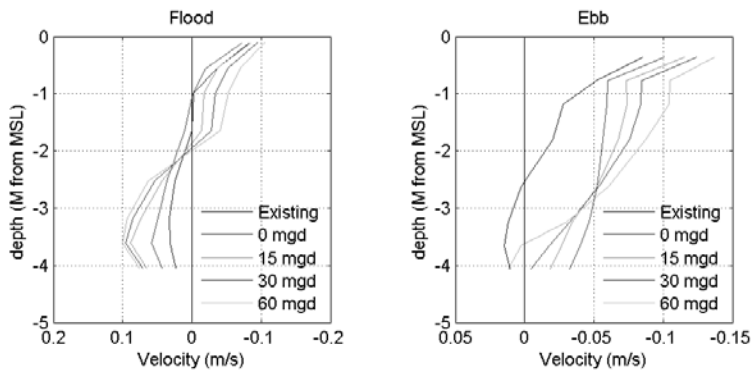

Figure 3-26: Velocity profiles at the harbor mouth for 75 mgd exhibit flow

3.3.6 Salinity

Salinity distribution in the new Marina is controlled by several different sources: the saline ocean water from the exhibits (75 mgd), brackish groundwater inflows, and the exchange between the existing Harbor (surface brackish water) and the ocean (bottom saline water). The vertical salinity distribution along a central cross-section of the new Marina for the simulations with low brackish groundwater inflow shows a very small variability in salinity with a small area of brackish water at the surface near the harbor entrance. Figure 3-27 and Figure 3-29 show the salinity contours for the cases with 0 mgd brackish groundwater inflow. Results from these simulations show high salinity concentrations at the far end of the Harbor in the range of 31 to 33 ppt. Overall, in these cases, the salinity within the new Marina remains higher than that in the existing Harbor. Figure 3-28 and Figure 3-30 show the salinity contours along transect NM (Figure 3-12) for the cases with 60 mgd brackish groundwater inflow. These cases show much more brackish water in the surface layers with saline water being confined to the bottom layers. It is observed in Figure 3-29 and Figure 3-30 that including the 75 mgd inflow of 34 ppt water from the exhibits reduces the stratification and increases the salinity concentration in the new Marina.

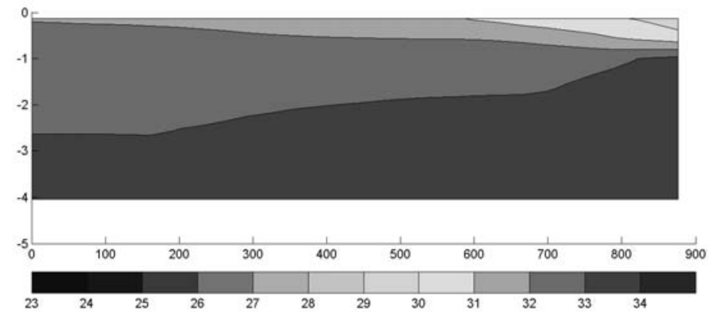

Figure 3-27: Salinity contours at flood tide (ppt) along Transect NM (Brackish discharge of 0 mgd)

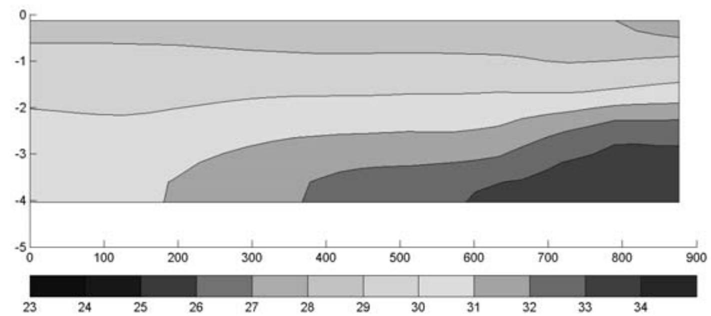

Figure 3-28: Salinity contours at flood tide (ppt) along Transect NM (Brackish discharge of 60 mgd)

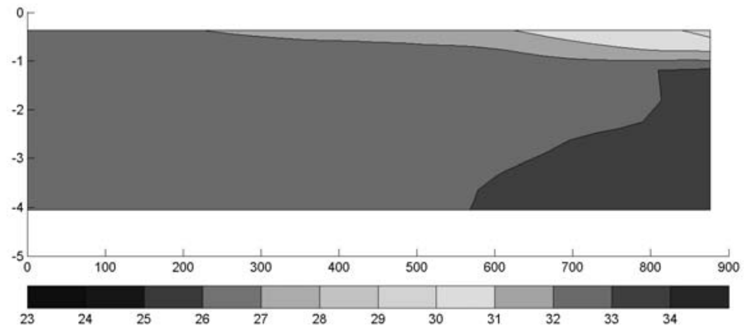

Figure 3-29: Salinity contours at flood tide (ppt) a along Transect NM (Brackish discharge of 0 mgd and exhibit discharge of 75 mgd)

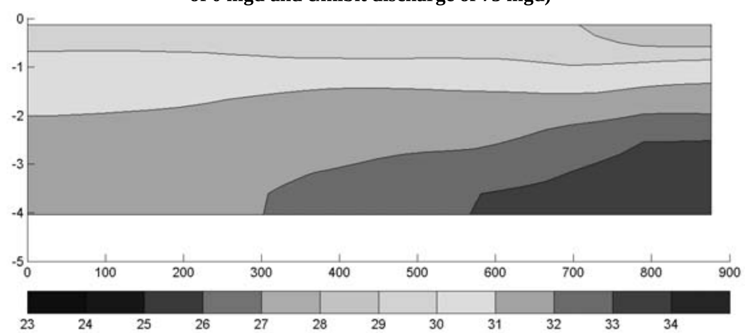

Figure 3-30: Salinity contours at flood tide (ppt) along Transect NM (Brackish discharge of 60 mgd and exhibit discharge of 75 mgd)

Salinity patterns within the existing Harbor are also altered under future conditions due to the change in circulation. Circulation between the two marinas impacted the existing Harbor decreasing its water exchange with the ocean significantly. This was already evident after examining the significant change in flushing times presented in Section 3.3.4. Figure 3-31 and Figure 3-33 show the net salinity changes along Transect EH (Figure 3-12) with 0 mgd of brackish groundwater inflow into the new Marina. In this case changes are small and limited to the region where the two marinas connect. In this region, the salinity in the surface layer slightly increases because the low salinity water in the top layer flows into the new Marina instead of towards the ocean. Figure 3-32 and Figure 3-34 show the net tidally averaged salinity changes along Transect EH associated with the simulated conditions brackish groundwater inflow of 60 mgd into the new Marina. In these cases, the salinity concentration throughout the whole existing harbor is significantly reduced. This is probably a consequence of the new circulation

patterns of the combined system, where the brackish layer flowing out of the new Marina flows into the existing Harbor under the existing fresher water of the surface, blocking denser ocean water from moving into the bottom layer of the existing Harbor. As a consequence, dense ocean water flows through the bottom layer into the new Marina under the exiting brackish water. The addition of the 75 mgd of saline water coming from the exhibits reduces this effect since the flow out of the new Marina is then slightly more saline. Therefore the reduction in salinity in the existing Harbor is less pronounced.

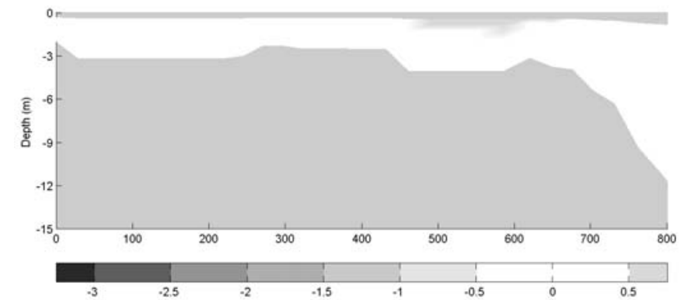

Figure 3-31: Salinity change (ppt) along Transect EH (Brackish discharge of 0 mgd)

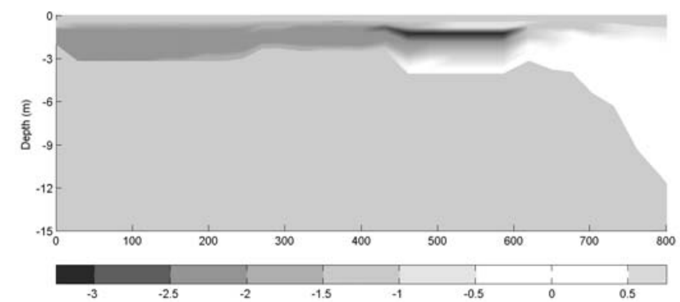

Figure 3-32: Salinity change (ppt) along Transect EH (Brackish discharge of 60 mgd)

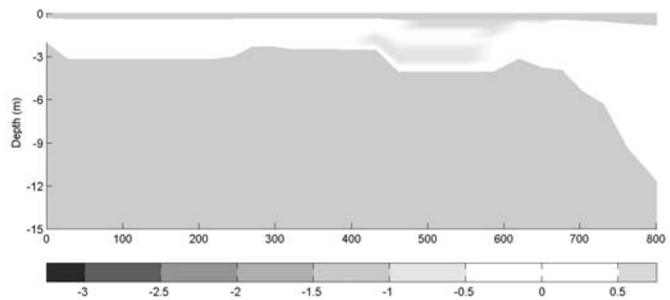

Figure 3-33: Salinity change (ppt) along Transect EH (Brackish discharge of 0 mgd and exhibit discharge of 75 mgd)

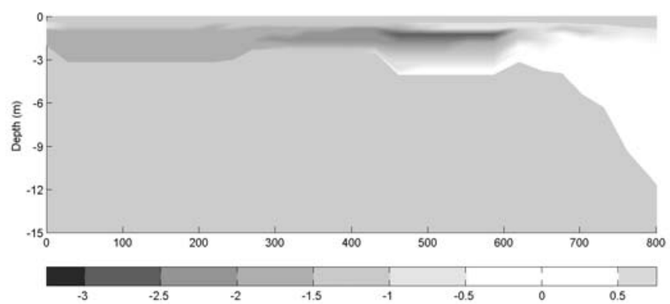

Figure 3-34: Salinity change (ppt) along Transect EH (Brackish discharge of 60 mgd and exhibit discharge of 75 mgd)

In order to further investigate the effects of the water circulating through the two marinas, the salinity profiles at the intersection of the new Marina and the existing Harbor (intersection, Figure 3-12) are shown in Figure 3-35. It is seen that as the quantity of brackish groundwater in the system increases, the well defined two-layer system present under existing conditions changes into a vertical distribution of salinity, which is almost linear over depth. This is observed for both cases with and without the 75 mgd of saline inflow from the exhibits, though the salinity through the middle to bottom layers is slightly more saline when the inflow from the exhibit is included.

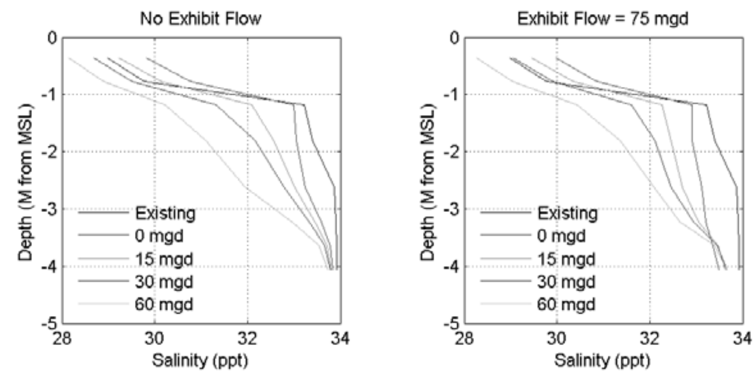

Figure 3-35: Salinity profiles at the intersection of existing and extended harbor

4. WATER QUALITY MODEL

The water quality module, Delft3D WAQ, simulates two-dimensional (2D, depth averaged) or three-dimensional (3D) transport and physical, biological and biochemical phenomena for a variety of model substances. The physical transport is governed by the advection-diffusion-reaction equation which is discretized for each computational cell. The physical transport is dependent on physical position, as is described in the hydrodynamic module. In addition to physical transport, Delft3D WAQ implements the biological and chemical reactions that affect each modeled constituent. This represents the complexity of interactions between substances and processes, which are independent of spatial position.

Delft3D WAQ is based on a flexible interface that allows the user to define the processes and components that are included within the model. The equations governing the processes for each substance are coupled together, giving a fully integrated water quality model. Given this, the computational time for the model increases with both the number of modeled substances and the complexity of the interactions. Process coefficients are defined within the model and are easily changed for calibration and sensitivity purposes. Initial and boundary conditions for the modeled substances can be defined within the model.

The model developed for Honokohau Harbor is necessarily site-specific. The substances and processes chosen for modeling are the ones most important to the overall water quality of the Harbor. The main goal of the study is to analyze the potential changes in water quality associated to the addition of the Kona Kai Ola Development including the new Marina and water exhibits. Therefore, it is important to develop a model to simulate the existing water quality conditions that can easily be extended to include the new developments. Of particular importance within the harbor are the aerobic conditions that are consistently observed in the existing Harbor. Modeling efforts presented here include the simulation of the existing conditions, and they also attempt to quantify the predicted changes to occur after the construction of the new development.

The kinetics that were implemented in the Delft3D-WAQ module were designed to predict the typical phytoplankton production in addition to this population's relation to the nutrient supply and the overall effect on the supply of oxygen within the water column. The model was designed to incorporate daily variation and seasonal variation; however, the data available did not provide seasonal or even daily variation. So the model was designed to predict an average value that was in line with the available data. This value is considered to be typical and this typical value is sufficient for the purposes of predicting the effects of the new development.

The substances used to quantify these conditions within the harbor are shown in Table 4-1. These values were chosen based on available data for input conditions and calibration (OI Consultants, 1991 and Ziemann, 2006). The interactions of the variables are described in detail in the following sections.

Table 4-1: Modeled substances

Phytoplankton	Diatom chlorophyll a
	Non-diatoms (green algae) chlorophyll a
Zooplankton	Herbivorous zooplankton
Nitrogen	Nitrate-nitrogen
	Ammonium-nitrogen
Phosphorous	Reactive phosphorous (ortho-Phosphate)
Silica	Reactive silicate
Oxygen	Dissolved oxygen

4.1 Model Grid and Hydrodynamics

The physical transport mechanisms necessary to drive the advection-diffusion equation are determined from the hydrodynamic model using Delft3D-FLOW. Hourly hydrodynamic updates were passed to the water quality model. The results of the hydrodynamic conditions were discussed and presented in the previous sections. The hydrodynamic results computed by Delft3D-FLOW were used to drive the water quality model. These hydrodynamics were coupled such that the Delft3D-WAQ module could easily derive the flow field and other parameters such as salinity and water temperature at each hydrodynamic time step. The model grid used for the hydrodynamic computations was also used for the WAQ model. The three-dimensional model grid was described in the hydrodynamic modeling section of the report. The vertical model discretization in 8 vertical layers allows for the simulation of the vertical variation in water quality parameters. Due to the complexity of the flow fields generated in Honokohau Harbor, this three-dimensional distribution is essential to understanding the water quality issues within the Harbor and surrounding areas. Horizontal dispersion was calibrated within the hydrodynamic model, and vertical eddy diffusion coefficients in the water quality model were computed by the hydrodynamic model using a k-ε turbulence closure scheme.

4.2 Temperature and Salinity

The biological elements (phytoplankton) present in the Harbor are strongly influenced by the temperature and salinity variation. The temperature dependency of the reaction rates has a uniform exponential equation.

$$k = k^{20} x k_T^{(T-20)}$$

k is the rate constant at some arbitrary temperature, T. The reference temperature for Delft3D-WAQ is considered to be 20 degrees Celsius, and k^{20} is the rate constant at this temperature. k_T is the temperature coefficient, which usually ranges between 1.01 and 1.10.

Temperature was determined within the Delft3D-FLOW hydrodynamic model. It included a heat-flux model taking into account air temperature, a typical wind speed and percent cloud cover. Evaporation and conduction were also included in the computation. Solar radiation was implemented within the Delft3D-WAQ model and controlled the quantity of light penetrating the water column.

Similarly to temperature, salinity variation has an effect on the biological and chemical reactions occurring within the Harbor. Salinity is also extracted from the hydrodynamic computation and is used to force the water quality model. Both salinity and temperature effects on the flow field are neglected within the water quality module as they were calculated within the hydrodynamic model. In fact, there is no feedback from the water quality module to the hydrodynamic module, and therefore none of the substances within the water quality module can affect or modify the flow field generated by Delft3D-FLOW.

4.3 Dissolved Oxygen

Dissolved oxygen (DO) is often taken as a representation of the health of a water body. Low values of DO indicate that the water is not able to sustain aerobic conditions and that the demand for oxygen exceeds the supply. The sources of DO within the water column come from reaeration at the water surface–air interface and the production of oxygen by phytoplankton during growth. Oxygen is utilized during nitrification, carbon decay, and respiration of both phytoplankton and zooplankton.

If the DO concentration is greater than the saturation concentration (supersaturation) at that temperature and salinity, the water will release oxygen to the atmosphere; however, if the water is undersaturated, then the water will take on oxygen from the atmosphere through reaeration. Stratification within the water column can cause significant water quality problems as the hypolimnion is not in contact with the atmosphere and cannot replenish the oxygen concentration from the atmosphere.

The only chemical reaction utilizing oxygen that is incorporated by Delft3D-WAQ in the Harbor simulations is the reaction converting ammonium to nitrate, which is discussed in Section 4.4. In addition, Deflt3D-WAQ contains the capacity to include collective parameters that indicate oxygen demand, such as Chemical Oxygen Demand (COD), or Biological Oxygen Demand (BOD) in order to encompass other processes and sources of demand that are not explicitly present within the model (WL| Delft, 2004). Available data on the oxygen demands on the system aside from nitrification were not available, and were not included in the model.

Phytoplankton respiration occurs during both day and night; however, primary production only occurs during the daylight hours, when photosynthesis can take place. Therefore, there is generation of oxygen occurs only during the day, while only consumption can occur at night. Due to this, there will be lower DO Oxygen values during the nighttime.

4.4 Nitrification

From a modeling perspective, nitrogen is difficult to model due to its loading pathways. In addition to the varying nitrogen species created from varying degrees of oxidation, loading may result from nitrogen-fixing bacteria and algae utilizing atmospheric N_2 gas directly to satisfy photosynthetic nitrogen requirements (when nitrogen is limited in the water column) or from bacterial conversion of organic nitrogen to NH_4-N at the sediment water interface. Nitrogen losses may occur due to denitrification (anaerobic conversion of organic nitrogen to N_2 gas) in the reducing environment found in the sediment-water interface. Additionally, nitrogen is generally identified with the dissolved water column constituents and cycles easily throughout the water column.

One of the significant sources of oxygen demand within a system is the nitrification of ammonium to nitrate. When a high ammonium loading comes from sewage or fertilizers, the

oxygen demand can be extremely problematic to these water systems. Ammonium in aerobic conditions is oxidized to nitrite by the bacteria Nitrosomonas.

$$NH_4 + 1.5O_2 \rightarrow 2H^+ + H_2O + NO_2^-$$

The nitrite formed is then oxidized to nitrate-nitrogen by the bacteria Nitrobacter.

$$NO_2^- + 0.5O_2 \rightarrow NO_3^-$$

Therefore the total oxygen utilization in the oxidation of ammonium is 4.57 g-oxygen per g-ammonia-nitrogen. In order for this process to commence, the conditions must be aerobic (DO>2.0 mg-O_2/L), o-P must be present, and the environment must be alkaline with a pH between 6.0 and 8.5.

The oxygen consumption due to the nitrification of ammonium is proportional to a nitrification rate (obtained from EPA: Lake Erie Model (1980)) and a function of the DO and ammonium concentration. If the system becomes anaerobic, denitrification takes place, although within Honokohau Harbor, this condition is not applicable.

4.5 Phytoplankton

Phytoplankton are non-motile, plant-like bacteria, which similarly to plants only grow, and thus release oxygen, in the presence of light. If phytoplankton are present in large quantities, they can consume the oxygen within the system through respiration and cause the system to become eutrophic. Phytoplankton growth is limited by the presence of consumers (zooplankton) and the availability of nutrients within the system. In Honokohau Harbor, two types of phytoplankton are considered, diatoms and non-diatoms (green-algae). Only two types were chosen for modeling due to the availability of only Chlorophyll a concentration values, so a sophisticated species specific model is unreasonable given the calibration data. A “typical” ratio of 25 mg-CHLa to 1g-C for phytoplankton (Chapra 1997) was used to convert between carbon and chlorophyll for the purposes of the model inputs. Diatoms and non-diatoms are differentiated only by the diatom’s silica requirement. The cell wall of the diatom is made up of silica and if there is a bloom of diatoms, a depletion of silica within the system would be noticeable. The stoichiometric composition of the diatom and the typical green algae (classical ratios for O:C:N:P (109:41:7.2:1) is similar in proportion neglecting the silica (Chapra, 1997).

Growth, or primary production, occurs during daylight hours and requires that there be enough nutrients present. The typical growth rate of maximum production was obtained from EPA: Lake Erie Model (1980). Nutrient dependency relates the growth rate of the phytoplankton to the external nutrient concentrations. Phosphorous, nitrogen, carbon, and silica (for diatoms) are the potential limiting factors, although in most models, carbon is not assumed to ever limit growth (Chapra, 1997). Delft3D-WAQ utilizes a model for primary production using Monod-type kinetics for the calculation of growth rates. Primary production is proportional to the biomass concentration and the gross primary production (growth) rate. The consumption of inorganic nutrients and production of DO is proportional to the net primary production (WL| Delft, 2004).

In order to determine the limiting nutrient for phytoplankton growth, the N:P ratio is used. The ratio of nitrogen to phosphorous in the biomass of phytoplankton is roughly 7.2 (Chapra, 1997). Therefore, a ratio in the water of less than 7.2 indicates that nitrogen is the limiting factor.

Conversely, higher ratios indicate that phosphorous will limit growth. In the case of Honokohau Harbor, the ratio of N:P in 1991 was approximately 6 which would make the system nitrate-nitrogen-limited. This was also the case pre-expansion (Bienfang, 1980). In 2006, the data presented by Ziemann shows the system o-P to be lower in concentration at all depths than in earlier studies (Bienfang, 1980 and OI Consultants, 1991) and the system appears to have become phosphorous-limited. This might imply that phosphorous loading has changed, since the groundwater ratios of NO_3-N to o-P remain fairly constant. The limiting factor has a significant impact on phytoplankton growth and is important to consider. Due to the apparent shift in limiting nutrients, the difficulty in calibrating the model between the two datasets is evident in later sections of this report.

For the purposes of this model, biological and chemical interactions with the sediment layer were neglected; however, the settling of phytoplankton is important and typical settling velocities were obtained from Burns and Rosa (1980) and from EPA: Lake Ontario Model (1975). The settling of phytoplankton only occurs when the bottom shear stress, computed in the hydrodynamic model, drops below a critical value. Dead phytoplankton are converted to inorganic nutrients, and the mortality is controlled by the biomass concentration and a mortality constant, which was obtained from EPA: Rates, Constants and Kinetics (1985).

4.5.1 Primary Consumption

The presence of primary consumers such as zooplankton can significantly impact the phytoplankton population in a system. This model accounts for the first level of consumers, the herbivorous zooplankton, however carnivorous zooplankton and higher levels of consumers were not included within the model. While the respiration of zooplankton has an effect on the DO content within the water column, this effect is ignored in Delft3D-WAQ (WL|Delft, 2004). The stoichiometry of the primary consumers is defined, and generally is considered to be related to the composition of their food supply. The uptake rate of phytoplankton biomass for food, respiration and mortality of biomass, and excretion of nutrients are included in the model (values obtained from EPA: Rates, Constants, and Kinetics, 1985). Concentrations of zooplankton were reported in OI Consultants (1991) and Bienfang (1982).

4.6 Model Conditions

The model was set up using Delft3D-WAQ which is a three-dimensional numerical model with the capacity for multiple substances and varying processes. The processes and substances included in the model set up were described at length in the previous section. The hydrodynamic conditions used to drive the water quality model were discussed at length in Section 3. The water quality model was developed to fit the processes and specifics of Honokohau Harbor under existing conditions. It was calibrated to data collected in 1991 (OI Consultants, 1991) and verified using data collected in 2006 (Ziemann, 2006). The proposed expansion of the Harbor was analyzed using the calibrated and validated numerical model to describe the changes that are expected to occur with the extension of the harbor and the additional loads associated with this new Marina.

The grid and bathymetry used for the water quality module were the same as those presented in the hydrodynamic section. Seasonal variability in the water quality model was not considered since such information was not available for calibration and therefore the model was

implemented under "typical conditions." A spring-neap tidal cycle was simulated; however, the model was calibrated to an average value and not to daily or tidal variability. In addition, neither variations in brackish water inflows nor variations in nutrient loadings were considered in the model. Daily variation was considered to the extent that phytoplankton do not grow without the presence of sunlight.

In order to drive the water quality model, conditions for all modeled constituents had to be specified at the initial time in addition to specifications at each boundary and inflow. The oceanic conditions shown in Table 4-4 were applied to every cell within the model as initial conditions. These conditions were also used at the offshore boundaries. The offshore boundaries were sufficiently far enough away from the site that the boundary conditions at the boundary have no immediate direct effect on the site conditions.

Initial and boundary conditions for the model were taken from site specific data sources when possible and supplemented with appropriate literature values. All of the initial and offshore boundary conditions were taken from the offshore transect data collected by Ziemann (2006). The transect data was taken over three days and at two depths: near the surface and near the bottom. The furthest point along all transects was 500 m from the shoreline (Table 4-2). This point was selected to represent the offshore conditions for the numerical model (Table 4-4)

Table 4-2: Offshore statistics (Ziemann, 2006 – 500 m from shore)

	Dissolved Oxygen (mg/L)	Silica (µg-Si/L)	Ortho-Phosphate-phosphorous (µg-P/L)	Nitrate-nitrogen (µg-N/L)	Ammonia-nitrogen (µg-N/L)	Chlorophyll a (µg/)
Mean	7.13	312.87	2.967	21.13	1.430	0.210
Standard Error	0.05	65.12	0.162	4.34	0.197	0.030
Median	7.14	172.50	3.000	14.00	1.100	0.145
Mode	7.05	173.00	3.000	5.00	0.500	0.130
Standard Deviation	0.29	356.70	0.890	23.75	1.077	0.166
Minimum	6.54	68.00	2.000	3.00	0.500	0.090
Maximum	7.94	1869.00	6.000	120.00	4.400	0.700
Count	30.00	30.00	30.00	30.00	30.00	30.00
Confidence Level (95.0%)	0.11	133.20	0.332	8.87	0.402	0.062

The selected offshore conditions were applied as the constant offshore boundary and also as initial conditions for the model. In order to convert the Chlorophyll a concentration to concentrations of diatoms and algae respectively, the ratio of 1:20 for diatoms to algae was used, which was consistent with data obtained by Brix *et al.* (2006) for their study in central Pacific waters. In addition, the typical value of 25 µg-CHLa/L to 1 mg-C/L (Chapra, 1997) was used to convert the measured data to model inputs and vice versa.

Data was also needed to provide the conditions for the brackish water inflows entering the system at the back of the Harbor. Several studies were conducted with respect to groundwater conditions in Honokohau Harbor. Waimea Water Services, Inc. (2006) published a report on the state of the groundwater and brackish water flowing into Honokohau Harbor. Cited in this report is the water chemistry from the project area that was collected in the 1996 study of the discharge from the Kealakehe wastewater treatment plant. This data was analyzed by AECOS Laboratories, Hawaii. Samples were collected from the Visitor Center, Quarry, Well #2 and Well #6 using a peristaltic pump to prevent contamination. This program revealed that the natural groundwater in the Quarry well (upfield of the Harbor) has higher nutrient loads than the water entering the Harbor (Harbor Spring) indicating that tidal mixing is diluting nutrient loads.

Three groundwater wells were installed by the USGS in 1996. These wells were located inland of Aimakapa pond, inland of Kaloko Pond, and inland of and between the two ponds. These wells were used for water quality sampling on five separate occasions (Oki *et al*., 1999; Brock and Kam, 1997; Nance, 2000; Tribble, 2003; and Bienfang, unpubl.). Using these five sets of data, Hoover and Gold (2005) developed the nutrient vs. salinity curves shown for all three wells. These curves show a fairly constant relationship of salinity with nitrate, phosphate, ammonium and silica and fairly good agreement among the five sets of collected data. Using this relationship an inference of nutrient values for the salinity of the brackish inflow to the Harbor can be obtained.

In addition to this study, Johnson *et al*. (2006) presented similar curves of nutrients vs. salinity and also found a linear relationship with the exception of nitrate, which they assumed to be exponential. For the purposes of this analysis, a linear relationship is used for all nutrients as was described in Hoover and Gold (2005).

A comparison of values derived from these recent data sets were checked against each other. Note, however, that the values obtained from Hoover and Gold (2005) and Johnson *et al*. (2006) were estimated from the graphs and that the NO_3-N curve from Johnson *et al*. (2006) were linearized for the purposes of this analysis. In addition, chemical analysis of the groundwater by Bienfang (1980) indicates that it has a NO_3-N concentration of 35.7 µg-atom/L and a o-P concentration of 2.4 µg-atom/L.

The concentration of nutrients within the groundwater are quite high (Bienfang, 1980), and the tendency of Honokohau Harbor would be towards eutrophication. This is only prevented by the high rate of flushing which is 87% faster than the calculated tidal flushing (3.2 days) (OI Consultants, 1991). Bienfang (1980) also noted Honokohau Harbor's "isolation from other affecting forces, such as run-off, river/stream, or domestic/industrial sewage inputs." This indicates that the nutrient loads within the groundwater entering Honokohau Harbor originate upland of the WWTP. A simple analysis in Appendix C evaluates pathways of WWTP effluent through the ground.

Table 4-3: Groundwater conditions from four sources

	AECOS (2006 Harbor Spring)	Hoover and Gold (2005) (22 ppt)	Johnson *et al*. (2006) (22 ppt)	Bienfang (1980)
NO_3-N	420 µg-N/L	336 µg-N/L	434 µg-N/L	499.8 µg-N/L
PO_4-P	-	46.5 µg-P/L	58.9 µg-P/L	74.4 µg-P/L
NH_4-N	3 µg-N/L	14 µg-N/L	-	-
SiO_2-Si	15,800 µg-Si/L	8,960 µg-Si/L	8,960 µg-Si/L	-

From Table 4-3 it can be seen that the values collected and extrapolated from fitted curves are all similar in quantity and magnitude. A first test indicated that the values from AECOS (Waimea Water Services, Inc. 2006) were reasonable in terms of model performance, but that NH_4-N levels remained too small. Therefore, the value of incoming NH_4-N was increased to the value reported by Hoover and Gold (2005).

Table 4-4: Offshore and Groundwater Conditions

Constituent	Offshore condition	Groundwater Condition
Nitrate-nitrogen (NO_3)	21.13 µg-N/L	420 µg-N/L
Phosphate-phosphorous (PO_4)	2.97 µg-P/L	60 µg-P/L(lower)
Algae(non-Diatom)	0.008 mg C/L	0 µg/L
Diatom	0.0004 mg C/L	0 µg/L
Dissolved Silicon	312.87 µg-Si/L	10,000 µg-Si/L
Ammonia-nitrogen (NH_4)	1.43 µg-N/L	14 µg-N/L
Dissolved Oxygen	7.13 mg/L	4 mg/L

While there may be other nutrient loads to the system, it was beyond the scope of this model to be able to predict or calibrate to unknown loads. The incoming brackish groundwater parameter that was estimated or calibrated to the model was DO. The DO concentration was not reported by Waimea Water Services (1996), and measurements displayed in Hoover and Gold (2005) show a range of values of 5 to 8 mg-O/L. Bienfang (1980) reported values for DO of about 5 mg-O/L at the back of the basin, and so it is reasonable to use a lower concentration than 5 in the brackish water flowing from the back of the basin.

4.7 Existing Conditions

The water quality within Honokohau Harbor has been shown in previous studies (Ziemann, 2006 and OI Consultants, 1991) to be quite good. This is primarily attributed to the high rate of flushing within the Harbor. While in earlier years, water quality within the Harbor was affected by bilge discharges from boats, wastewater additions and other pollutants, the conditions currently seem to indicate that those sources have been decreased if not eliminated. The phosphorous loads on the system have apparently decreased between 1991 (OI Consultants, 1991) and 2006 (Ziemann, 2006). This is corroborated by the increase in the N:P ratio from approximately 6 to more than 15, indicating either a decrease in phosphorous loading or an increase in uptake by the resident algal population. An additional observation from all the datasets was a general decrease in concentration of nutrients at mid-Harbor, indicating a change in volume/bathymetry at approximately the location of the Harbor expansion (Phase I). An increase in nutrients near the Harbor mouth at approximately sampling station 7 (Ziemann 2006) tends to indicate an unidentified source. These broad conclusions about the change in water quality should be carefully considered because the data collected by Ziemann (2006) contains only one sample that may or may not represent a broad view of current conditions within Honokohau Harbor.

In order to calibrate the model to existing conditions, the calibration data points had to be determined. While the most recent data are preferable as descriptors of current conditions, the data were limited to one sample at each point. The less recent OI Consultants dataset (1991) was taken over a three month period with six total sets of data. This dataset was chosen, if only due to more reliable "typical" conditions. The 2006 data are used to provide additional verification as to the model's ability to predict these "typical" conditions. While the conditions and limiting nutrient may have changed since 1991, the trends and order of the model results are still reasonable.

Calibration of the model was performed with six different constituents ("benchmarks"): Silica (Si), NO_3-N, NH_4-N, o-P, DO, and Chlorophyll a. Due to the similarity of the station locations in 1991 and 2006, it was possible to compare some stations simultaneously with the model results. In these cases, the figures are labeled with Station 1/A, which indicates that the comparison is with Ziemann (2006) station 1, and OI Consultants (1991) Station A. The station locations are shown in Figure A-1 and Figure A-3 for Ziemann (2006) and OI Consultants (1991) respectively. However, a direct comparison is precluded because the surface samples were taken at differing depths.

The model used a certain amount of time to "spin up" or achieve quasi-steady state solutions to all of the processes involved. After this time period, which was about 10 days, the values of the model were extracted and averaged over the rest of the model run. Each model was run for a 1 ½ month period. The resulting means and standard deviations are compared to the geometric means of the OI Consultants (1991) datasets and the values obtained by Ziemann (2006). Note that the model standard deviation is only representative of the daily and tidal variability. OI Consultants (1991) took samples at three depths; however, due to changes in bathymetry or conditions on the day of sampling, some of the depths are below the model depth which is zero at MSL. Points which are not displayed fell outside the range that is shown on the figure. These points represent either aberrations in data or inability of the model to predict the large sample

variability. Average model results are shown as black solid lines, with the standard deviation shown as a dotted line. OI Consultants (1991) geometric mean data is shown as red circles, while Ziemann (2006) data is shown as blue circles. Ziemann (2006) took data points at 0.3 m from the surface and 0.5 m from the bottom (at unspecified tidal cycles) while OI (1991) sampled at 0.5 m from the surface, 1.5 m and 3.0 m from the surface for ebb and flood tides.

4.7.1 Silica (Si)

Silica concentrations within Honokohau Harbor changed between 1991 and 2006. The values obtained in 2006 are higher than those collected in 1991. This is especially evident in the surface layer. Figure 4-1 shows the calibration for the silica model results and data. The model performed well by correctly simulating the vertical distribution and magnitude of the depth variability; however, the differences between 1991 and 2006 were too extreme to be captured by the model. Similarly to the other nutrients discussed in the following sections, silica is present in high quantities in the upper layer throughout the existing Harbor .Silica concentrations were highest at the back of the Harbor and decreasing toward the mouth, establishing groundwater as the loading source. The lower layers tend to have either more "clean" sea water or more diatoms that consume the silica. Therefore, concentrations in these layers tend to be less. However, the concentrations of silica in the Harbor increased significantly from 1991 to the 2006 measurements. This would tend to imply a shift in the algal populations away from silica consumers (diatoms), co-incident with the overall system shift from nitrogen-limited to phosphorous-limited.

4.7.2 Nitrate-nitrogen (NO_3-N)

NO_3-N concentrations within Honokohau Harbor also changed between 1991 and 2006. This is indicated by the apparent system shift from nitrogen-limited to phosphorous-limited, leaving excess inconsumable NO_3-N. However, the values are not very different. They are still within the same order of magnitude, and the model matches that magnitude along with the vertical distribution (Figure 4-2). Higher NO_3-N concentrations are found in the surface layer, where there are fewer phytoplankton to consume it. Deeper in the water column, more phytoplankton are present due to slower velocities and warmer temperatures. Stations closer to the Harbor entrance have a more drastic vertical distribution due to the influx of "clean" sea water in the lower layers and the high nutrient brackish water in the upper layers. Again, there is an apparent decrease in concentration in surface samples mid-Harbor (possibly indicating a change in volume or bathymetry that would dilute the load of NO_3-N) and an increase near the mouth (indicating an unidentified source at that location).

4.7.3 Ortho-phosphate (o-P)

The axial and vertical distribution of o-P follows the trends of both nitrate-nitrogen and silica, since it is subject to similar effects. Concentrations were higher in surface samples at the back of the Harbor and generally become lower due to dilution and consumption. A spike in concentration near the Harbor mouth (Ziemann (2006) station 7) implies an additional and unidentified load is entering near the Harbor mouth. The model performs well in replicating this distribution. The o-P concentrations are significantly lower in 2006; however these levels are still within the same order of magnitude of the values collected in 1991.

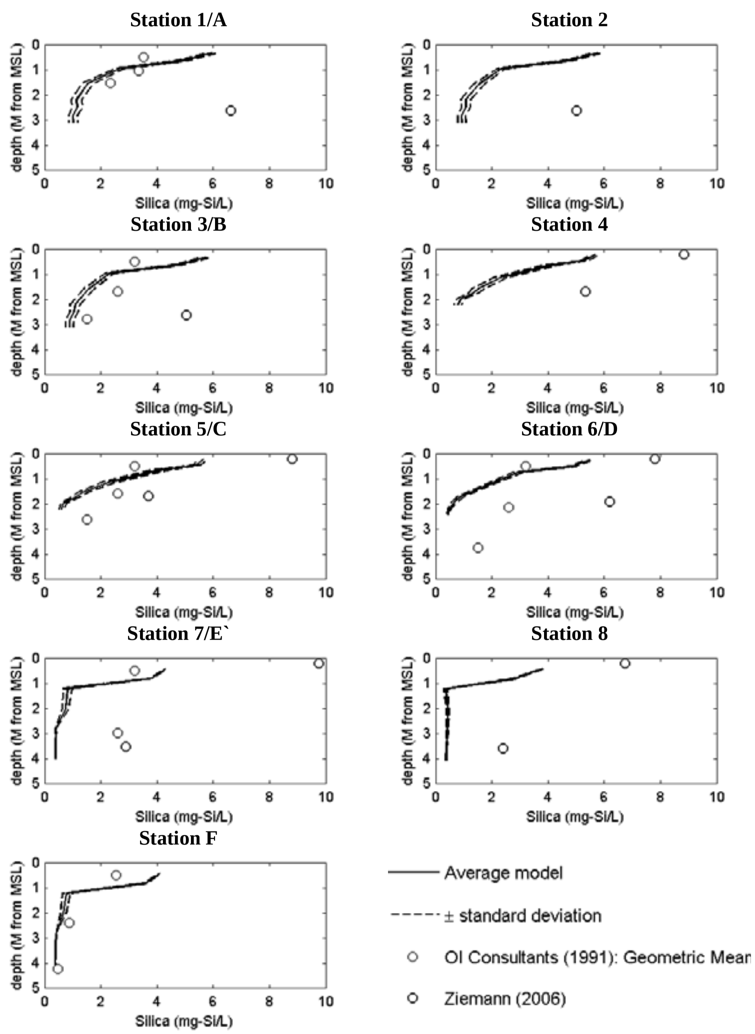

Figure 4-1: Silica (Si) calibration

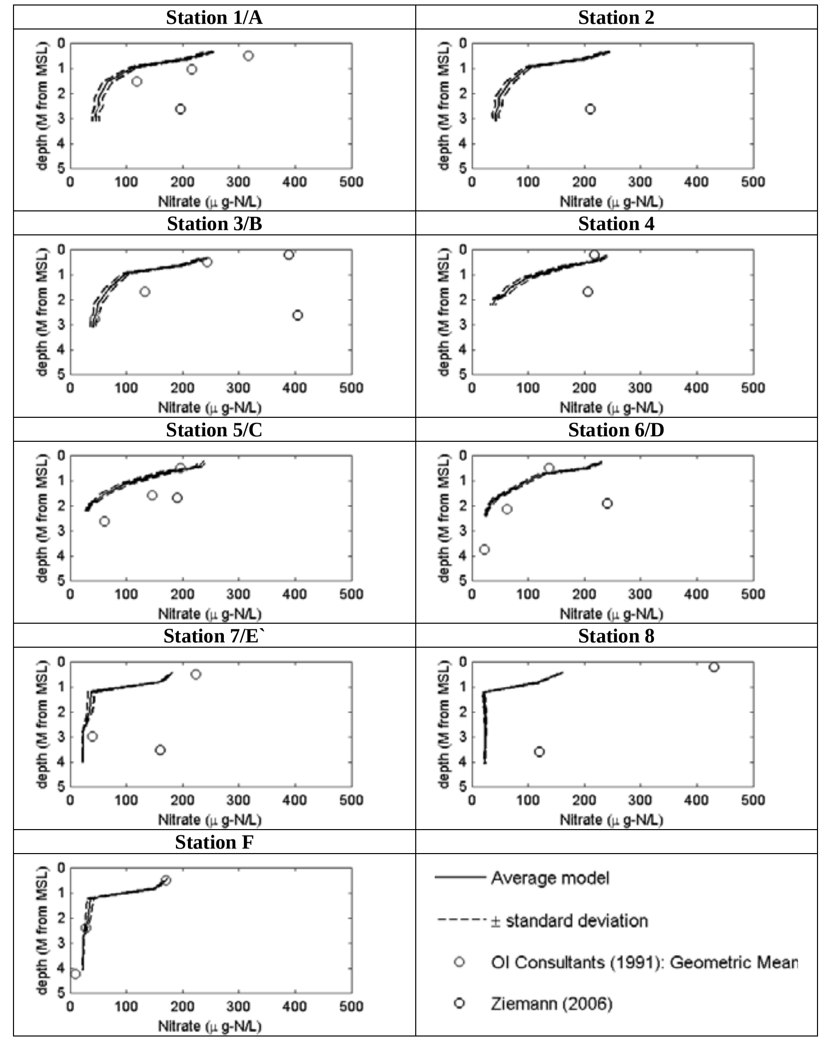

Figure 4-2: NO_3-N calibration

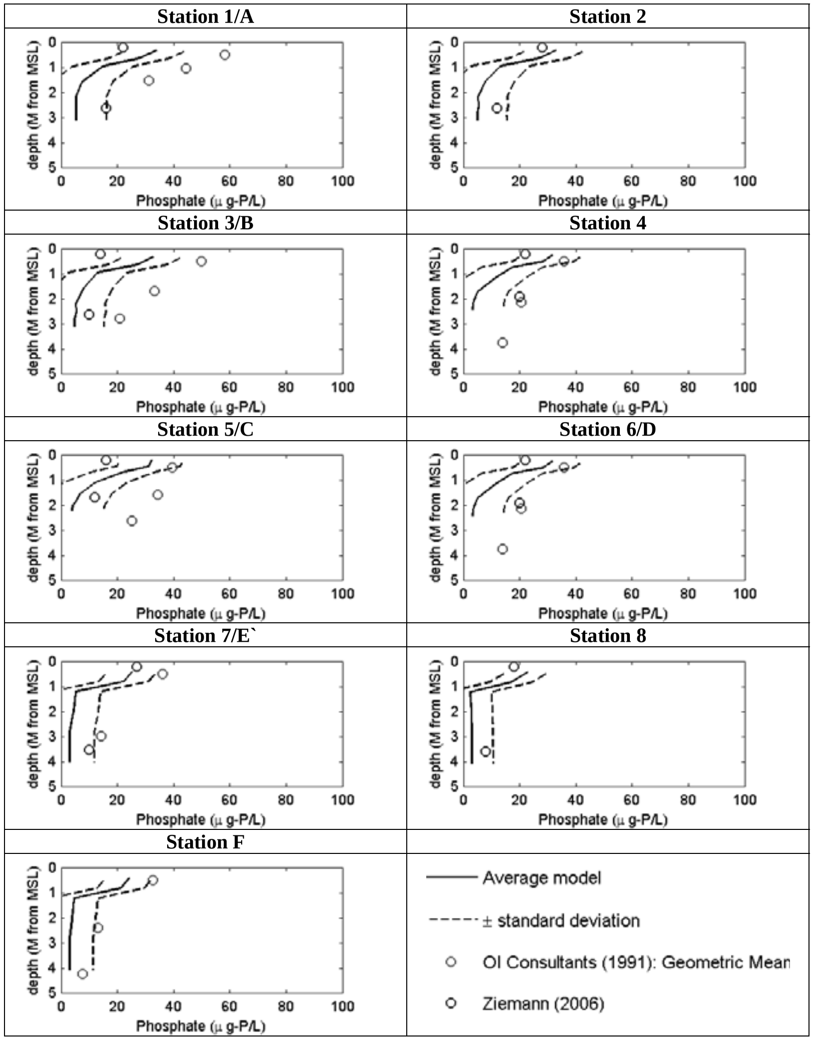

Figure 4-3: o-P calibration

4.7.4 Ammonia-nitrogen (NH_4-N)

The ammonia-nitrogen load into the system is fairly small and seems to agree well with the data. From both 2006 and 1991 (Figure 4-4), the vertical distribution is similar to the other nutrients presented and the model seems to perform well with this distribution. However, in the calibration, ammonium is underestimated at all stations, indicating that loading of the constituent (described in datasets) is insufficient. Corroborating evidence was found in the co-incident overestimation in DO at all Harbor stations. Given the slightly higher values of ammonium-nitrogen in 1991, it is apparent that a shift in loading has occurred, possibly from improvements in a nearby wastewater treatment system. Coincidentally, the DO deficit has also improved significantly from 1991 to 2006, verifying that reductions have occurred in ammonium loading.

The significant increase in concentration measured in the 1991 data set indicates that an additional load may have been introduced between Ziemann (2006) stations 4 and 5. This location corresponds to a restroom that is treated by septic tanks and discharged into the groundwater (Hoover and Gold, 2005). It is presumed that this immediately flows into the existing Harbor, causing a significant ammonia-nitrogen increase as well as a subsequent change in the DO content within the water column. This was tested within the model by adding an additional ammonia load at this point in the model to examine the effects. Figure 4-5 shows the results of the model including this additional load. However, this test load is not considered in the subsequent future conditions section, as it is stated in the EIS submitted on 15 June 2007 that all sewage currently treated by septic tanks will be rerouted to the wastewater treatment plant as part of the project.

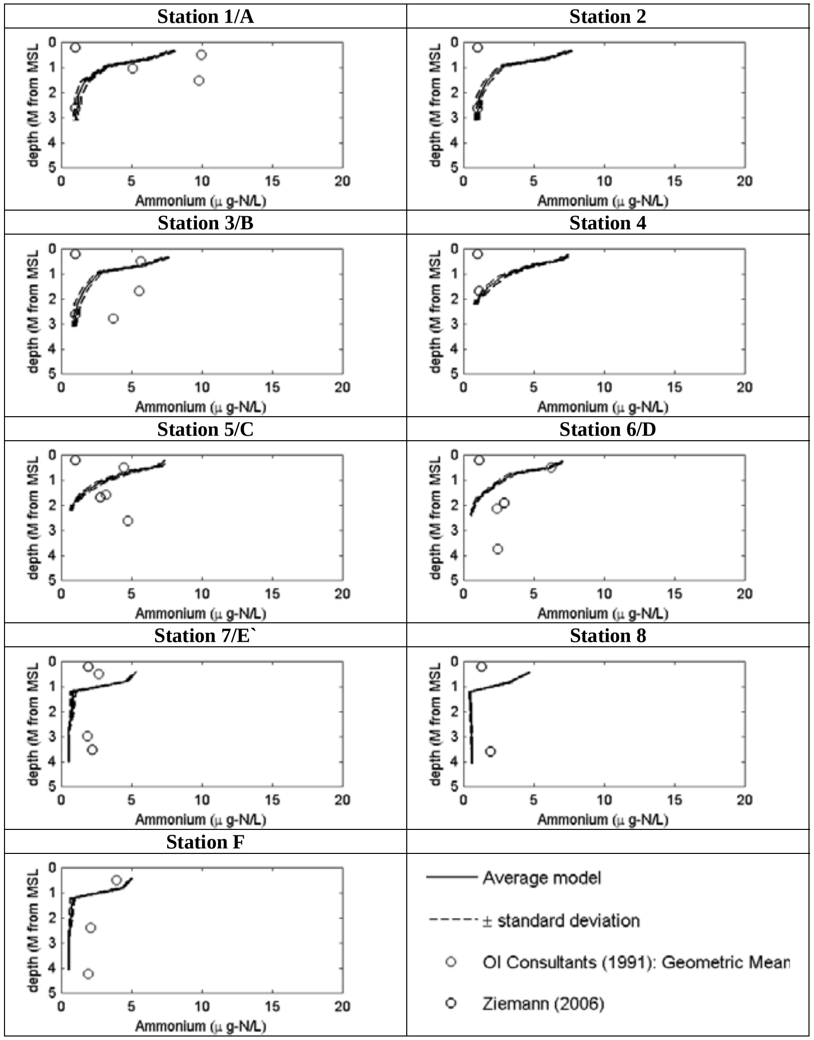

Figure 4-4: NH_4-N calibration

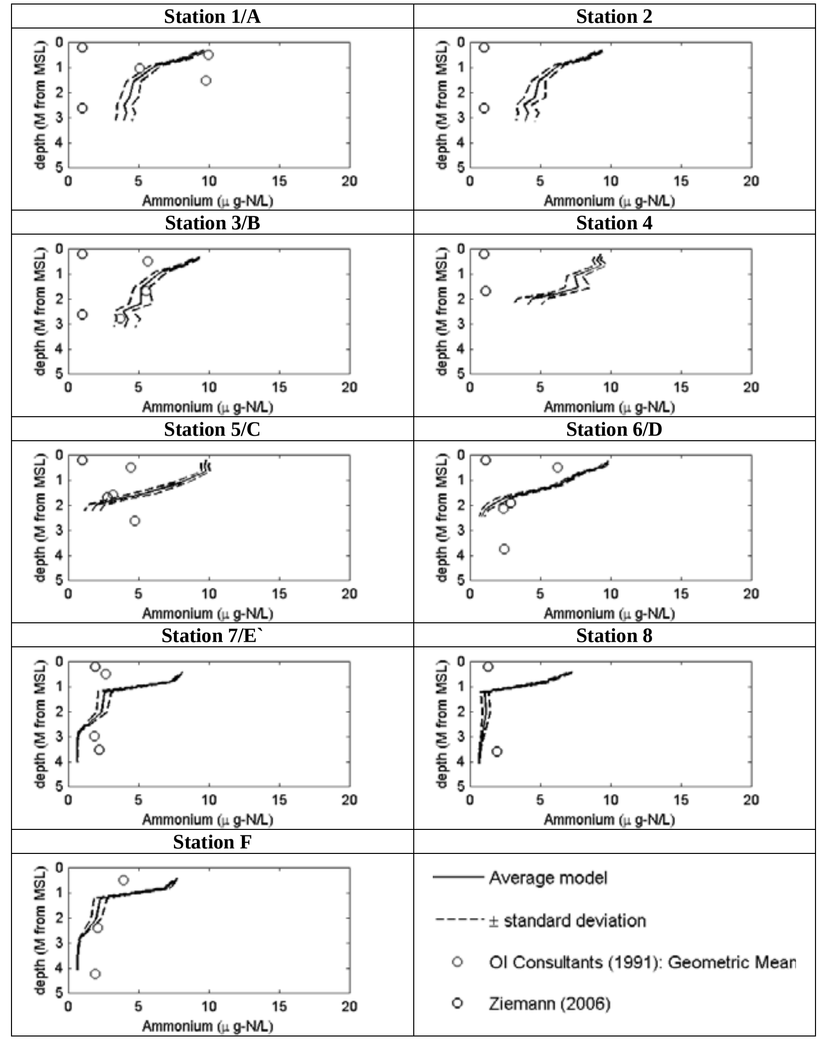

Figure 4-5: NH_4-N with extra load

4.7.5 Dissolved Oxygen (DO)

The DO profiles (Figure 4-6) show that the DO concentrations are lowest at the surface with the low oxygen content coming from the groundwater. As the water gets deeper and there are more phytoplankton growing and producing oxygen and more saline ocean water with DO values around 7.1, the oxygen content gets higher. This seems to corroborate the data from both 1991 and 2006. While the 2006 DO measurements are slightly lower than the data presented in 1991, the DO deficit is actually lower (DO is a function of salinity and temperature), indicating that there has been overall improvement of (i.e., a decrease in) DO-demanding loads in the Harbor since 1991. However, the calibration of DO is overestimated at most of the stations, providing insight that an additional and unknown oxygen-demanding load is not being addressed.

The extra load of ammonia that was discussed in section 4.7.4 is another sink of DO, requiring 4.57 g-O/L per g-N/L. The effect of this was minimal in terms of the vertical distribution of DO within the water column. To avoid repetition, the additional plots are not shown. Since the input of ammonia-nitrogen due to the restroom inflow was 14 µg-N/L, under maximum oxidation, it would only impact the DO by 0.06 mg-O/L, which is not resolvable in the calibration plots. However, it is worth noting, that this effect does exist, and the greater the NH_4-N load on the system, the greater the impact on the DO concentration.

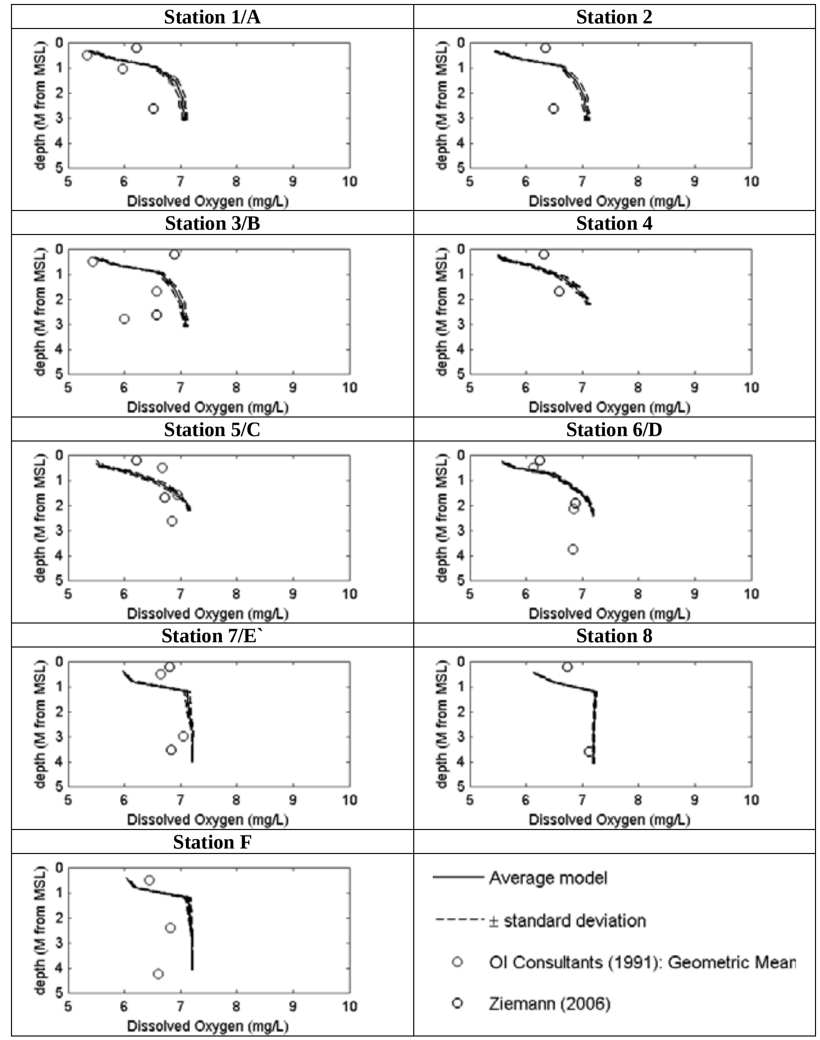

Figure 4-6: DO calibration

4.7.6 Chlorophyll a (CHLa)

Chlorophyll concentrations were extremely variable, especially within the OI Consultants (1991) datasets. Extremely high values were observed at Stations B and C that were too large to fit within the data represented by Figure 4-8. These large values were not replicated in the data collected by Ziemann (2006). The chlorophyll curves that were generated with the model follow the vertical distribution shown by the data and as observed in Bienfang (1982) and OI Consultants (1991). They describe the main vertical position of the algae to be centered in the middle layer of the existing Harbor due to the unfavorable conditions in the top layer (low salinity and temperature), and the light penetration constraint nearer to the bottom of the Harbor (Figure 4-7).

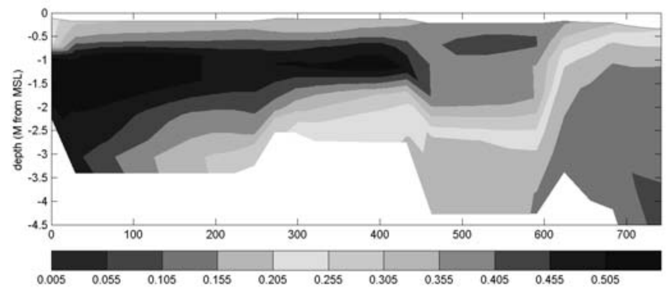

Figure 4-7: Algae concentration (µg –CHL a/L) along Transect EH (Figure 3-12)

It is seen that the chlorophyll has much higher values in the interior of the basin, especially in the middle layer. Nearer to the harbor mouth, the oceanic water dominates the bottom layer and there is less phytoplankton growth. This is also observed in the depth profiles in Figure 4-8, where in the interior basin, the maximum chlorophyll values are in the middle layer of the inner basin. The outer basin has much more stratified layer.

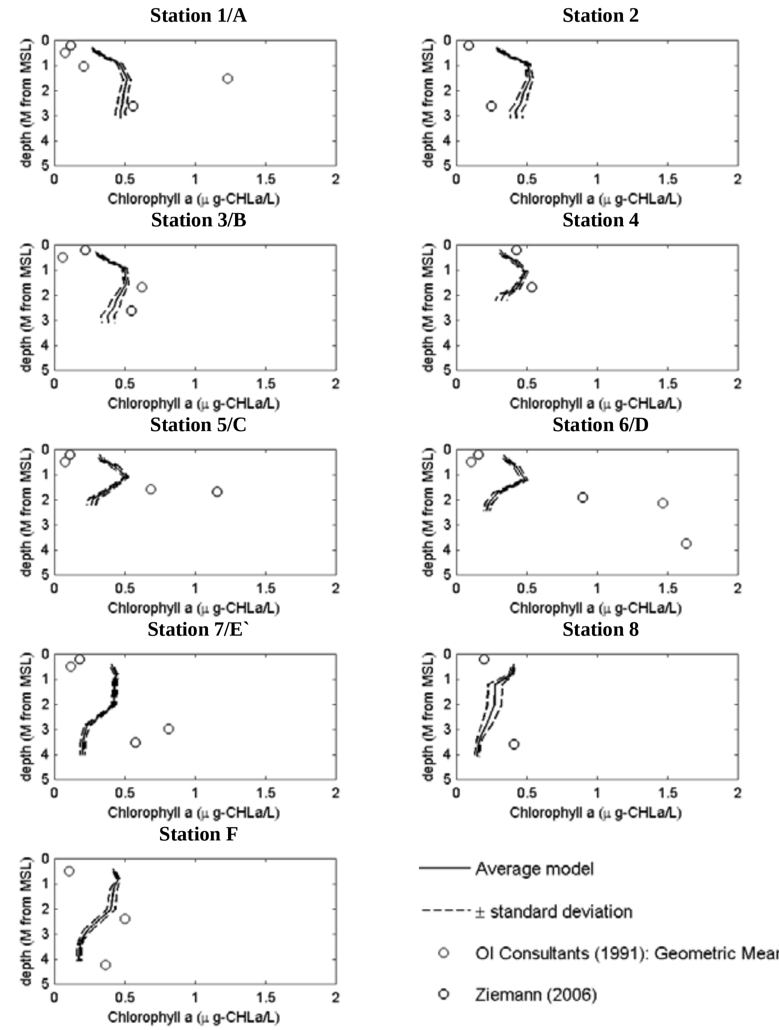

Figure 4-8: Chlorophyll a calibration

Concentrations of benchmark constituents (NO_3-N, o-P, NH_4-N, Chlorophyll a and DO deficit) calibrate well at the back and mouth of the Harbor. This implies that the flushing volume and time, as well as constituent loads, were adequately quantified during calibration. Table 4-5 shows the comparison of the model results with the data variability. It can be seen that in all cases the model difference was less than or equal to the standard deviation of the data, which indicates that the model performance is reasonable.

Table 4-5: Model agreement with data

	Model difference from data (maximum) (1991)	Standard Deviation (data, 1991)	Model difference from data (maximum) (2006)
Silica (mg-Si/L)	2.20	3.19	5.48
Nitrate (mg-N/L)	0.11	0.67	0.46
Ortho-Phosphate (mg-P/L)	0.03	0.03	0.02
Chlorophyll a (mg – CHLa/L)	0.005	0.006	0.0008
Dissolved Oxygen (mg-O/L)	1.09	1.31	1.42
Ammonium (mg-N/L)	0.01	0.01	0.01

4.8 Future Conditions

The following assumptions were made in the determination of future performance of the Honokohau and Kona Kai Ola Marina system. These assumptions were both necessary and appropriate for the typical conditions simulated.

Wastewater Treatment Plant (WWTP) influence on the Groundwater: The high nutrient loads entering the harbor system through the groundwater are not likely to decrease from those observed in the existing Harbor, and therefore it is necessary to find a project alternative that primarily reduces the flushing time within the system to a level that will successfully expel the nutrient laden water from the system. In addition, nutrient levels in the groundwater are considered to be the same as those in the brackish groundwater entering the existing Harbor. Although nutrient levels in Well #6 (Waimea Water Services, 2006) located near the future location of the new Marina are higher than those in the brackish water entering the existing Harbor, the higher levels are likely a direct influence of the WWTP. It is assumed that nutrient levels in the brackish groundwater entering the new Marina will be similar to those entering the existing Harbor, which correspond to groundwater unaffected by the WWTP inflow (see Appendix C). To achieve these conditions the WWTP will be upgraded to tertiary treatment.

Additional point or nonpoint sources into the new Marina: It is assumed that the project will implement point and nonpoint source water pollution control measures. Therefore, simulations included in this study do not include any additional sources. If these control measures were not implemented and additional sources of nutrients are allowed to enter the new marina, results presented in this report could not represent future conditions.

Groundwater consumption: It is assumed that no additional groundwater will have to be withdrawn from the aquifer to be used in the new development and therefore the groundwater levels and volumes will remain the same as existing conditions. Groundwater withdrawal will likely decrease the amount of brackish water reaching the harbor system and coastline. Oki et al. (1999) modeled this reduction using a three-dimensional groundwater model, and found that the decrease in freshwater discharge within the Kaloko-Honokohau National Historical Park could be as much as 0.44 mgd of fresh groundwater. This was obtained by increasing withdrawals upland by about 1.6 mgd. If water is withdrawn from the aquifer it may alter the current amount of brackish groundwater entering Honokohau Harbor. A full groundwater study complete with a three-dimensional, tidally-coupled, variable density groundwater model would be needed to project these effects on existing and proposed conditions.

Groundwater brackish inflow: Since the exact quantity of brackish groundwater inflow to the new Marina is unknown, this value was bracketed between the values of 0 and 60 mgd as in the previous section. Ziemman (2006) indicated that the new Marina will capture brackish groundwater flow that is currently flowing towards some ponds and areas with vegetation downstream of the location of the new Marina. In addition Waimea Water Services (2007) states that a significant quantity of brackish water will be intercepted by the new Marina. Therefore, although the exact amount of brackish groundwater that will be intercepted by the new Marina is unknown, it seems that some amount will be flowing into the new Marina. The effects to the downstream ponds is unknown without a quantity of intercepted groundwater. While some of the solutions shown in the following sections provide adequate water quality conditions post-expansion, it is worth noting that one of the major controlling factors is the brackish groundwater inflow, and without an accurate estimate of this value, a reliable prediction of post-expansion conditions cannot be obtained. In order to estimate the intercepted brackish groundwater flow by the new Marina, a more detailed monitoring effort would be required. This effort will also be used to determine the density differences spatially and in depths below the surface. A tidally coupled variable density groundwater model would also be recommended and would be beneficial to determine the effects of the new Marina construction.

Exhibit Discharge: Discharge from the water exhibits includes nutrient loadings calculated as a function of the marine animal present in the exhibits. The water drawn from the ocean for the marine exhibits was taken from a 100 m depth offshore. This water is drawn approximately along the line of Transect D in Figure 4-9 at 500 m from shore. Due to its depth, at pumping, the temperature of the water is about 3 degrees less than surface water, and this is assumed to increase approximately 1 degree during its retention in the exhibit area. Nutrient loads were determined using a feed ratio of 2% of the population body weight (502 kg/day), and computing the quantity of ammonia-nitrogen (15.06 kg/day) and suspended solids (150.62 kg/day) related to this feed ratio. This resulted in a total ammonia-nitrogen concentration of 53.8 µg-N/L in the exhibit flow entering the new Marina. All computations with regard to the exhibit flow were performed by ClowardH2O (2007) and are documented in Appendix D.

The exhibit also introduces a load of total suspended solids which represents a certain unknown quantity of Carbonaceous Biochemical Oxygen Demand (CBOD) that could further impact the DO. However, results show that the overall impact on the DO in the system is fairly minimal due to the large amount of water inflow with high Dissolved Oxygen concentrations and the high levels of primary production. In addition, compared to the oxygen demand required to satisfy the nitrogenous BOD (NBOD) load coming from the ammonia-nitrogen, the oxygen demand for carbonaceous load is expected to be minimal.

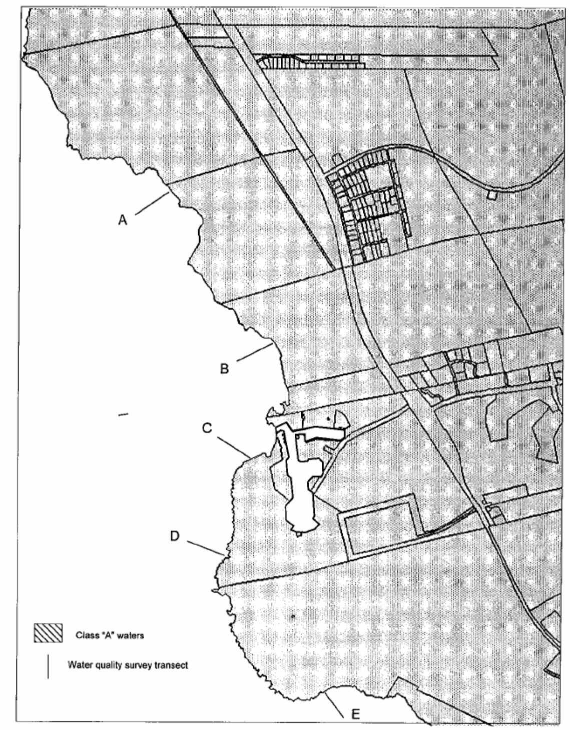

Figure 4-9: Transect location (Ziemann, 2006)

4.8.1 Nutrients

As presented in Section 3.3.4, for all projected scenarios, flushing time is increased, thus, algal residence time is increased within the Harbor. As phytoplankton spend more time within the Harbor without being flushed out, they are able to consume more nutrients. To determine the limiting nutrient under the new conditions, the ratio of nitrogen to phosphorous (N:P) is examined in (Table 4-6). It is shown that the system containing the new Marina is phosphorous-limited. As more o-P is introduced with the brackish groundwater, the N:P ratio decreases but still remains phosphorous-limited. Further discussion of the phosphorous limitation is found in 5.4.2.

Table 4-6: Nitrogen to Phosphorous (N:P) ratio inside existing harbor

Case	N:P ratio within existing harbor	N:P ratio at harbor mouth
Discharge 0 mgd	10.8	8.8
Discharge 15 mgd	8.6	8.2
Discharge 30 mgd	8.3	8.2
Discharge 60 mgd	8.0	8.0

Under low brackish inflow conditions, the addition of phosphorous to the system is immediately utilized. This is compounded by the fact that the need for nutrients is greater due to the longer period of time that phytoplankton remain within the system. It can be seen from Figure 4-10 and Figure 4-11 that the nutrient levels within the existing harbor are depleted much more in all of the future cases than they are under existing conditions. It is also worth noting, that the NO_3-N concentration is reduced more with increasing brackish groundwater discharge (indicating more utilization), because of increased loading of the limiting nutrient, o-P. This is corroborated by examining the o-P concentrations by loading scenario: o-P concentrations are depleted the most with 0 mgd of brackish groundwater inflow, and concentrations increase with higher loadings of brackish groundwater. This not only supports the argument of the phosphorous-limitation on the system, but also indicates that there is sufficient NO_3-N within the system to continue to support more influx of o-P and subsequently more phytoplankton production.

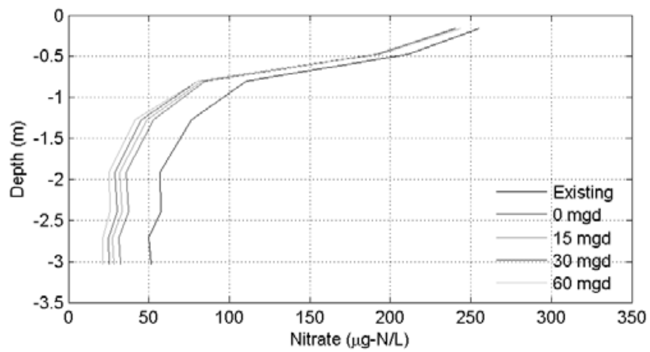

Figure 4-10: NO_3-N concentrations in inner existing Harbor (Figure 3-12)

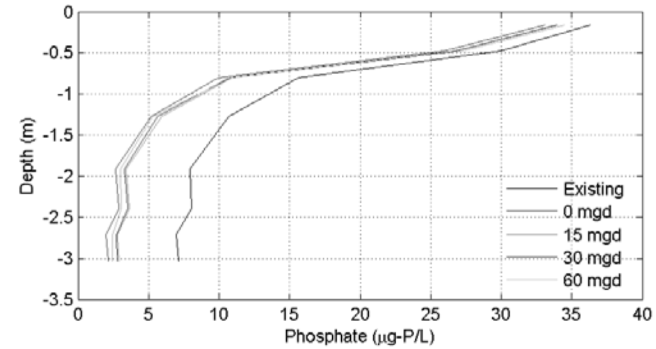

Figure 4-11: o-P concentrations in inner existing Harbor (Figure 3-12)

While this may result in a decrease in NO_3-N and o-P concentrations, it may increase the total nitrogen and total phosphorous loads to the system due to production of N and P substances with the death of phytoplankton.

Due to the phosphorous limitation on the system described, the ammonia introduced from the exhibit flow does not significantly affect the chlorophyll production within the system, as will be shown in a later section. This is not to say that this inflow does not affect the water quality within the system. The load is a significant DO sink, and it causes the system to be even more phosphorous deprived. This deprivation can lead to problems as any new phosphorous source can cause a significant algal bloom.

4.8.2 Dissolved Oxygen

The NBOD load being exerted by the incoming exhibit flow is equivalent to 0.28 mg-O/L. However, due to the high DO content in the exhibit discharges, the model predicts that this load will not adversely affect the DO concentrations. Modeling of the DO within the system shows a daily variability, due to the consumption without production during the nighttime, however the concentration of DO never drops to levels that would be considered problematic. This is due to the high concentration of oxygen in the exhibit flow in combination with the oceanic circulation. It appears that even with the NBOD load, the system remains aerobic. Water quality standards for Hawaii require that the DO remain >75% of the saturation DO for the specific temperature and salinity regime, so that even aerobic systems may violate the State water quality standard. Current data (Ziemann 2006) indicate that the Harbor DO concentrations are approximately equal to DOSat; thus, additional BOD loads should be carefully assessed for impacts to assure compliance with state water quality standards. It is noted that CBOD loads that were not accounted for within the model could do much to impact the DO concentrations in the exhibits and consequently, in the Harbor.

The indicators of phosphorous limitation in section 4.8.1 and the chlorophyll values described in the following section all lead to the conclusion that there will be sufficient algal response from the exhibit-loaded nutrients to affect mesotrophic and possibly eutrophic conditions within the Harbor. Under these conditions, the concentration of DO in the system is likely to decrease significantly, although this is not shown by the model. With a significant increase in algal population, nutrient cycling may effect a substantial re-loading of ammonium back into the water column from bacterial activity at the sediment: water interface[17] resulting in additional NBOD demands on the Harbor DO concentrations. These processes were not included within the existing model due to their relative unimportance within the context of the existing water quality system.

4.8.3 Chlorophyll a

The major focus in the modeling of the system was to project the trophic state of the Harbor following the construction of the new Marina. As discussed in Section 3.3.4, the flushing time of the existing Harbor increased by almost double in most cases due to internal circulation between the new Marina and the existing Harbor. This immediately presents the possibility that the algae growth within the existing Harbor may increase, due to the increased phytoplankton residence time in the Harbor. In addition, the internal circulation is projected to transfer algae and nutrients between the two harbors, without expelling those substances into the ocean. Another problematic factor is that there is also a constant input of phytoplankton and nutrients from the exhibit discharge. All of these factors contribute to increased phytoplankton growth and a potentially eutrophic situation.

Simulation results indicate that increases could be on the order of 10 to 50 times the amount of chlorophyll present under existing conditions (< 1 µg-CHLa/L). Figure 4-12 through Figure 4-15 show the changes in Chlorophyll a concentration within the existing Harbor. It can be seen that significant changes occur throughout the existing Harbor and are not limited to areas adjacent to the new Marina. Despite the decreased flushing time with increased brackish water inflow, conditions are worsened with the largest brackish groundwater discharge simulated, with concentrations 7-8 µg-CHLa/L higher under the new conditions. This is due to the higher nutrient load added by this brackish groundwater inflow. In addition, since the new system is phosphorous-limited, any addition of phosphorous to the system will be immediately consumed by the phytoplankton and will cause rapid growth.

[17] Substantial increases in organic nitrogen loading from death of the larger phytoplankton population result in subsequent settling and accumulation on the bottom. This thicker layer of organic material at the bottom causes effects such as mineralization and denitrification to become important, which can impact the DO significantly within the system.

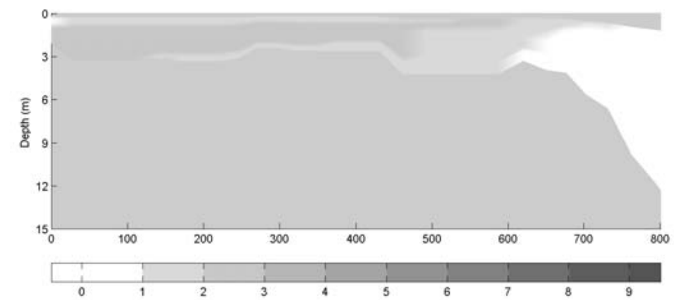

Figure 4-12: Change in Chlorophyll a concentrations (µg-CHLa/L) along Transect EH for 0 mgd brackish discharge

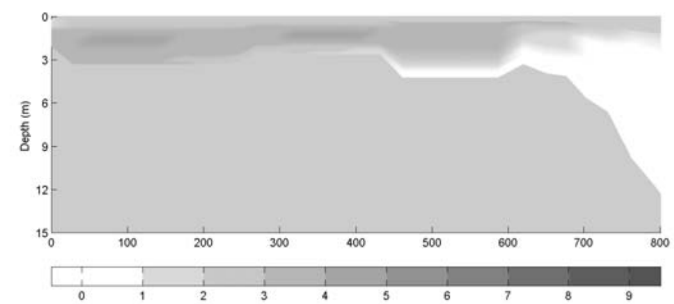

Figure 4-13: Change in Chlorophyll a concentrations (µg-CHLa/L) along Transect EH for 15 mgd brackish discharge

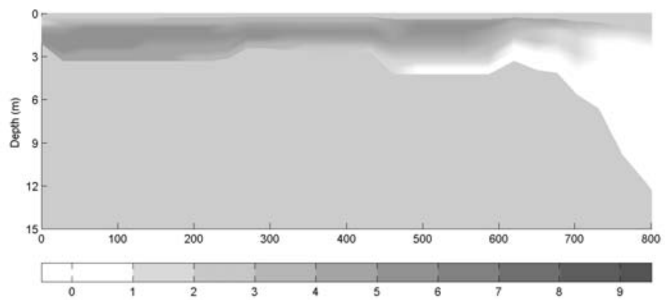

Figure 4-14: Change in Chlorophyll a concentrations (µg-CHLa/L) along Transect EH for 30 mgd brackish discharge

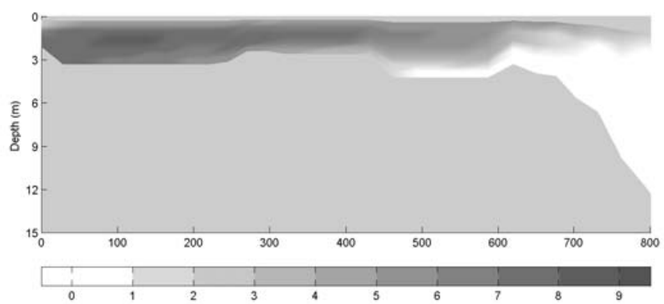

Figure 4-15: Change in Chlorophyll a concentrations (µg-CHLa/L) along Transect EH for 60 mgd brackish discharge

In addition to the increase in flushing time, exhibit and brackish groundwater loads are projected to cause a substantial shift in the system. The water quality within the existing basin becomes degraded as planktonic growth increases. Thomann and Mueller (1987) define a eutrophic system to be one which has chlorophyll values in excess of 10 µg-CHLa/L. For the simulated scenarios, the model-projected conditions will degrade to a mesotrophic level with chlorophyll levels consistently within the range of 4-10 µg-CHLa/L. The resulting increase in chlorophyll levels in the existing harbor may be as high as 8 µg-CHLa/L. The existing system is very oligotrophic with chlorophyll levels remaining below 0.5 µg-CHLa/L. The high levels of Chlorophyll a and the system's sensitivity to phosphorous inputs indicate that with any new point or non-point loads containing phosphorous could advance the system from mesotrophic to eutrophic conditions

It should be noted that conditions reported in both Bienfang (1982) and OI Consultants (1991) reported high values of Chlorophyll a in isolated regions or at specific times; however the model

projections predict that under the typical conditions simulated, almost all locations will have Chlorophyll a values in excess of 4 µg-CHLa/L, the boundary for mesotrophic conditions. Therefore, it stands to reason that during certain times of year, these levels could be much higher.

The only condition that limits the phytoplankton population significantly enough to keep the existing Harbor and new Marina oligotrophic is the condition where the brackish groundwater discharge is 0 mgd. In this case, the o-P concentrations are so small, that the phytoplankton growth is limited by this condition. However, this is not a probable condition due to the high porosity of the rock in the project site, and could only be achieved if the entire new Marina were lined. It is worth noting that even under these conditions any point or non-point sources of o-P would immediately trigger phytoplankton growth, and due to the high flushing time, this would reach undesirable conditions quickly.

The impacts of this change in system dynamics also extend offshore, as the algae and diatoms are carried out of the Harbor. OI Consultants (1991) and Maragos (1983) have shown that coral communities have continued to be established within the Harbor even with the extensions. OI Consultants (1991) reported that the coral population increased from 2.3% to 6.3% between 1981 and 1991 (mostly within the outer harbor).[18] The potential for eutrophication within Honokohau Harbor and the proposed Kona Kai Ola Marina could cause damage to the existing coral populations within Honokohau Harbor and inhibit further growth (Costa *et al*., 2000).

Within the new Marina, there are significant phytoplankton populations that are especially prevalent in the back basin (Figure 4-16 through Figure 4-19). This area of the new Marina has the longest flushing time and is the most saline region of the basin. The water quality in this region may be improved with the introduction of a piped water source coming into the new Marina at a certain flow rate to enhance circulation; however due to the high nutrient levels in the inflow, it is suspected that without a significant reduction in flushing time, the phytoplankton production will remain a problem throughout the new Marina.

[18] In earlier discussions, it is surmised that a population shift may have occurred between the diatoms and phytoplankton. The increased concentration of silica in the Harbor (Ziemann 2006) may indicate that diatom populations have decreased under the phosphorous-limited regime (thus, less uptake of silica). Thus, a small increase in phosphorous may restore the balance of diatoms:phytoplankton, yet the projected water quality degradation from increased nutrients, may mask any benefit to the population dynamics.

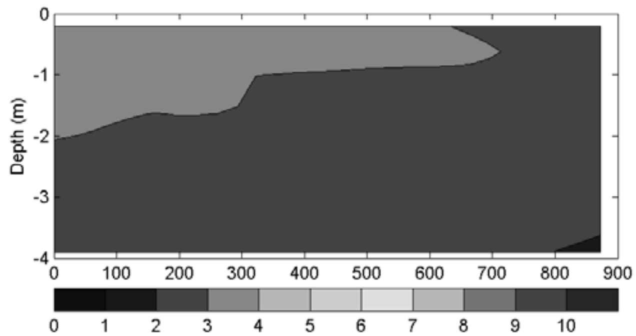

Figure 4-16: Chlorophyll a concentration (µg-CHLa/L) along Transect with brackish inflow of 0 mgd.

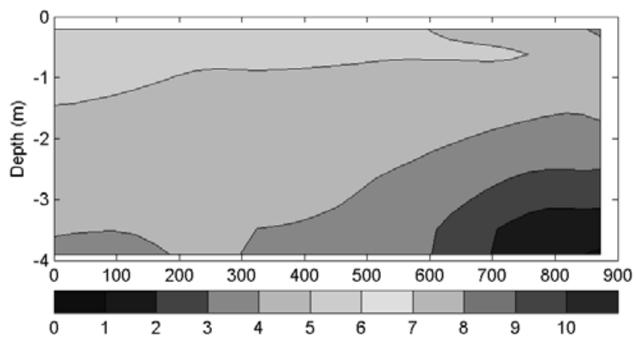

Figure 4-17: Chlorophyll a concentration (µg-CHLa/L) along Transect NM with brackish inflow of 15 mgd.

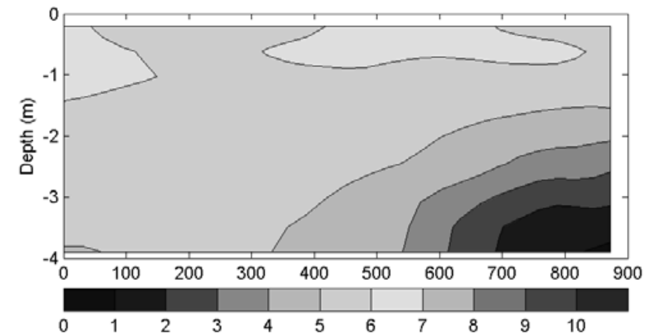

Figure 4-18: Chlorophyll a concentrations (µg-CHLa/L) along Transect NM with brackish inflow of 30 mgd.

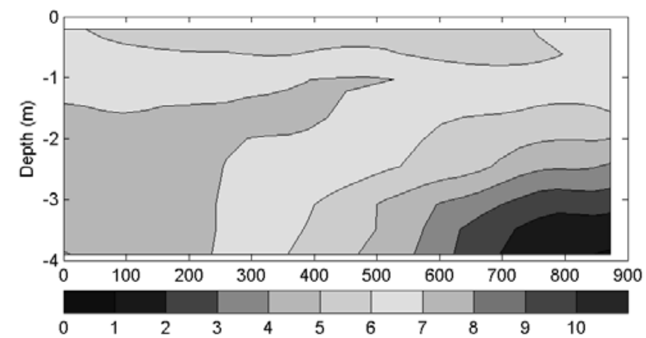

Figure 4-19: Chlorophyll concentrations (µg-CHLa/L) along Transect NM with brackish inflow of 60 mgd.

In addition, the projected chlorophyll leaving the harbor in the upper layers is in much higher concentrations than were found under existing conditions. This will affect the turbidity of the water significantly, as Bienfang (1982) attributed the turbidity within the Harbor to phytoplankton production. Outside of the Harbor, the waters also experience a change in Chlorophyll a concentration in the upper layers. This is important, as it will affect the light entering the water column and may impact biological systems in the nearby area. Figure 4-20 shows the vertical profiles of chlorophyll in the position of station J (OI Consultants, 1991), which is at about the 10 m depth contour outside of the harbor mouth. It can be seen that the surface layers of chlorophyll change significantly with the addition of the new Marina. At lower depths, the change is very slight.

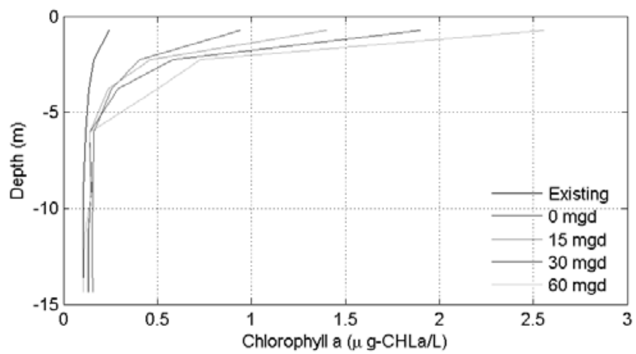

Figure 4-20: Chlorophyll profile outside of Honokohau Harbor (Station J Figure 3-12)

The conditions that were described in the previous section are shown to have unacceptable water quality conditions for all of the bracketed brackish groundwater conditions. Due to the fact that the nutrient loads within the new Marina are phosphorous limited post-expansion, it also indicates that the loads from the exhibit waters are likely not the cause of the additional algae growth within the system. This is further investigated in the following chapter. Since it is not feasible to control or treat the loads coming through the brackish groundwater, it is necessary to find an alternative that will increase the flushing of the new Marina and existing Harbor. The flushing is impaired in the above scenarios due to the internal circulation that exists between the two basins. It is necessary to control this circulation to keep the system flushing and decrease the time spent within the new Marina and existing Harbor by nutrients and algae.

5. ALTERNATIVES TO THE CONCEPTUAL MASTER PLAN

Results presented in the previous section suggested that for the new 45-acre Marina included in the conceptual Master Plan, the existing water quality conditions at Honokohau Harbor could not be maintained in the future two marina system, within the groundwater inflow ranges that were assumed in this study. If the inflow is determined to be greater than 60 mgd, the proposed Marina could be reevaluated. Therefore, it is necessary to examine alternatives to the proposed plan in order to find a solution that is not detrimental to the existing and future harbor system and surrounding waters.

Due to the limiting and unique conditions experienced in Honokohau Harbor and its environs, the mitigation alternatives are required to be unique. As was discussed in Section 3.3.5, a significant impact that occurs with the construction of the new Marina is the introduction of internal circulation between the two Marinas. In order to improve flushing and water quality, it is recommended that this internal circulation is minimized in order to separate the system into 2-layer systems that mimic the pumping that currently exists. The EPA's recommended Best Management Practices for increasing flushing of marinas suggest a number of different options (EPA, 2001: Section 4.1).

- Changing the size or shape of the entrance channel,
- Adding more than one entrance channel,
- Using mechanical aerators in problem areas,
- Optimizing the geometry such that there are as few separated basins as possible, and
- Changing the size of the basin.

The use of mechanical aerators is likely ineffective if not harmful to flushing enhancement in this system. While mechanical aerators may increase the amount of oxygen within the system, they will also vertically mix the system degrading the density stratification that is driving the current flushing. It will also mix nutrients into the bottom layers, which causes concerns for the native coral populations.

The change in size of the new marina is investigated at length in the following sections. Another unique alternative to this system would be to alter the controllable inputs to the system, such as the exhibit outfalls. The placement and inclusion of these outfalls is also investigated in the following sections.

Any further investigation of alternatives needs to be prefaced with an estimation of the inflow of groundwater to the system. Previous and future sections of this report demonstrate the controlling influence of this inflow on both flushing and nutrient loads. Further mitigation investigations will be subject to this estimation.

Adding another entrance channel to the new Marina also was not investigated. The possibility of making the Kona Kai Ola extension an entirely separate entity, leaving Honokohau Harbor entirely intact is another potential solution that could be considered. In this scenario, the internal circulation between the two marinas would be negated, allowing each to function independently.

In this scenario, it is possible that both will flush sufficiently. This option would still depend primarily on the influx of brackish groundwater.

EPA's Best Management Practices (EPA, 2001, Section 4.1) also stress the importance of harbor geometry to flushing. It also claims that the less semi-separated basins a marina contains, the faster the flushing. This was exemplified in the previous chapter's discussion on the internal circulation effects. Due to the geometry of the linkage between Honokohau and Kona Kai Ola Marina which are essentially separated basins with a connection, the circulation between the two marinas was complex and destructive to the water quality. It is likely that if the new Marina was positioned such that it was in line with Honokohau Harbor (like a large box), the flushing of the total system would be improved.

While all of these practices have the potential for improved water quality, the most appropriate practice, or combination thereof, is still dependant on the quantity of brackish groundwater expected to enter the new Marina.

5.1 Assumptions

The assumptions made in order to asses future conditions in Kona Kai Ola Marina (Section 3.3) were maintained for the Alternative analysis.

5.2 Simulated Scenarios

The calibrated hydrodynamics and water quality models described in Chapters 3 and 4 were applied to simulate future conditions for each of the considered alternatives. In this particular application, alternatives were limited to varying the size of the new Marina and the placement of the exhibit discharge; this is due to the computational demands of each test and the need to vary the unknown brackish inflow. In the future, the model could also be used for other alternatives not considered in this study. Table 5-1 and Table 5-2 show the significant computational effort conducted as part of this study. Simulations from Table 5-1, which considered an 800 slip marina as described in the Conceptual Master Plan, were discussed in the previous section with the exception of cases 9 and 10 that consider an alternative location for the exhibit flow outfall.

Table 5-1: Scenarios for 800 slip new Marina

Proposed Harbor Size (800 slips)		
Simulation number	Quantity of Brackish Discharge	Location of Exhibit Discharge
1	0	Back of New Marina
2	15	Back of New Marina
3	30	Back of New Marina
4	60	Back of New Marina
Proposed Harbor Size (800 slips)		
5	0	None
6	15	None
7	30	None
8	60	None
Proposed Harbor Size (800 slips)		
9	0	Back of Existing Harbor
10	60	Back of Existing Harbor

Simulations in Table 5-2 were conducted with a 400 slip marina, variations in the exhibit flow outfall location, and variations in the amount of brackish groundwater that could be intercepted by the new Marina. The 400 slip marina represents a reduction in volume by half of the 800 slip marina. Note, that the purpose of reducing the size in the simulations was to reduce the volume volume of the marina and this was independent of the number of slips that the Marina will finally have. The goal of this large number of simulation is to asses under what future project conditions water quality conditions within the Harbors and along the coastline of the state Park could be optimized.

The model that was constructed and described in Section 3.3 was modified to represent a new Marina layout that would effectively reduce the original volume by approximately one half. The resulting model grid is shown in Figure 5-1. For simplicity, the bathymetry within the Marina was kept the same as previously described. The goal of the reduction was to lower the flushing time within the new and existing Marinas and remain as close as possible to the conditions that presently exist within Honokohau Harbor.

Hydrodynamic, flushing time, and water quality numerical models were implemented using the conditions described in Section 3.3. The tidal conditions for the water quality model were further constrained to only represent one representative tidal cycle repeated in order to increase computational efficiency for the large quantity of simulations that were considered. This repeated signal is shown in Figure 5-2. Note that the model is representative of typical conditions and therefore neglecting the spring/neap variability of the tidal signal should not influence the conclusions extracted from the comparison of alternatives. Furthermore, sensitivity tests were carried out to compare results between simulation with a repeated representative tidal cycle and with a complete spring/neap tidal signal. These tests indicated that simulated water quality conditions are mainly controlled by the different water inflows into the system (groundwater brackish water and exhibit flow) and that tidal variability only incorporates some variability into the parameters. Water quality simulations with the repeated representative tidal cycle were carried out until the conditions in the harbor have achieved a relative steady situation.

Table 5-2: Scenarios for 400 slip Marina

Proposed Harbor Size (400 slips)		
Simulation number	Quantity of Brackish Discharge	Location of Exhibit Discharge
11	0	Back of New Marina
12	10	Back of New Marina
13	20	Back of New Marina
14	30	Back of New Marina
15	60	Back of New Marina
Proposed Harbor Size (400 slips)		
16	0	None
17	10	None
18	20	None
19	30	None
20	60	None
Proposed Harbor Size (400 slips)		
21	0	Back of Existing Marina
22	10	Back of Existing Marina
23	20	Back of Existing Marina
24	30	Back of Existing Marina
25	60	Back of Existing Marina

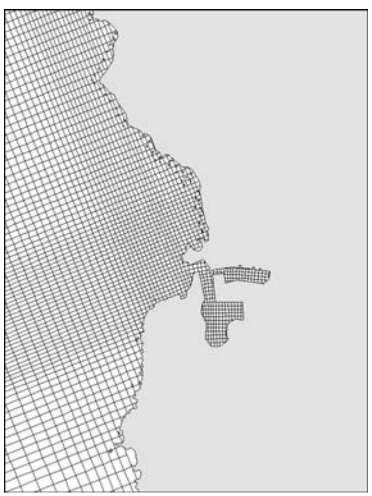

Figure 5-1: Adjusted grid for 400 slip Marina

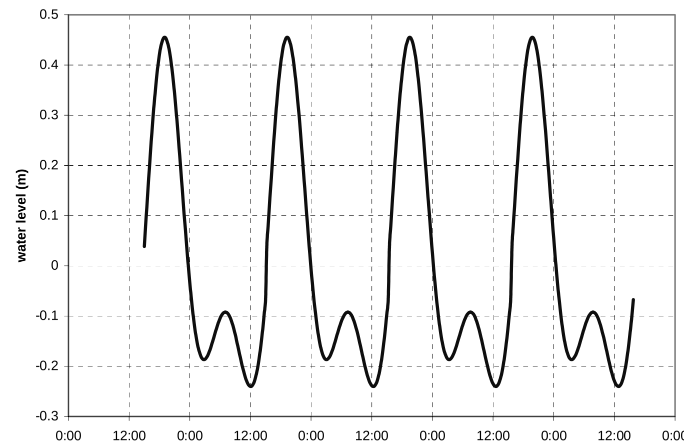

Figure 5-2: Repeated tidal cycle used for water quality simulations

5.3 Flushing Time

The major indicator of the water quality of a harbor is its flushing time. Ferreira et al. (2005) reported that flushing time is the most significant controller of eutrophication and biodiversity within a system. Flushing time results of the simulations using the 800 slips Marina of the Conceptual Master Plan described in Section 3.3 are also presented in Figure 5-3. Cases where the exhibit outfall discharges at the back of the new Marina were considered. In order to assess the effects of the discharge on the marinas, it was also excluded from the model in order to test the model's reaction to its inclusion. This condition could be representative of discharging the outfall offshore or eliminating the exhibits altogether. For the 800 slip marina, all cases showed a significant increase in flushing time from the current conditions. Flushing time increased in the existing Harbor from 12 hours to values up to 35 hours when no brackish groundwater inflow is considered in the new marina. At the new Marina flushing time could reach values up to 60 hours when neither brackish groundwater inflow nor exhibit flow is considered. Adding the exhibit flow into the existing marina proved to be effective in reducing the flushing time in the existing harbor from the aforementioned values particularly for the case of 60 mgd brackish groundwater inflow into the new Marina. The new Marina is not affected significantly by the change in pipe location. However, the values indicate that the situation still may not meet the water quality conditions that currently exist within Honokohau Harbor and indicate that water quality still may be impacted post-expansion.

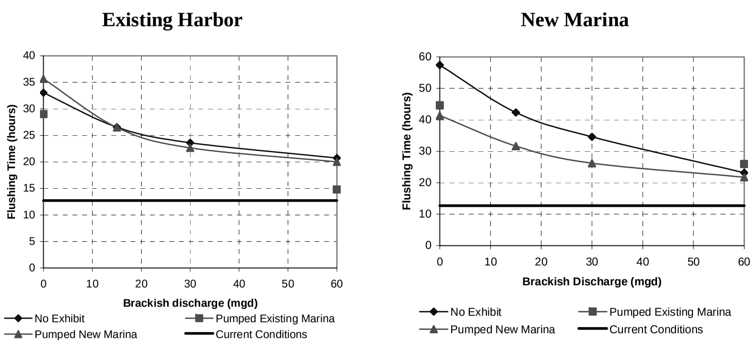

Figure 5-3: Flushing times of 800 slip marina

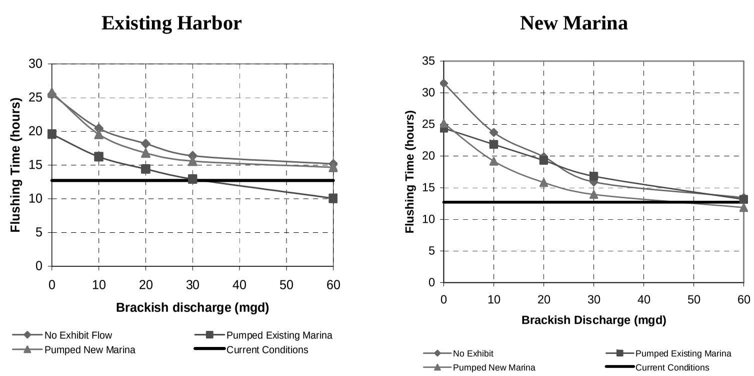

Figure 5-4: Flushing times of 400 slip Marina

In order to decrease the flushing time of the two-marina system, a reduction in the size of the proposed Marina was considered. Comparison of Figure 5-4 with Figure 5-3 shows that the reduction of the Marina size to 400 slips significantly affects the flushing times in both the existing and new Marinas for all the cases simulated. The influence is about five hours, which is significant when considering that the phytoplankton growth in a system with unlimited nutrients is exponential in time. In addition, pumping the exhibit discharge into Honokohau Harbor clearly reduces the flushing time in the Harbor significantly (> 5 hours: 25% improvement at Q=0 mgd and 50% improvement for Q=60 mgd), and pumping it into the new Marina also has an effect, but one that is less pronounced due to the size of the new Marina (2-3 hours). The flushing times under high brackish groundwater inflow conditions are comparable to the flushing

times under existing conditions, which may be sufficient to control algae growth within the new Marina. It should be noted that while the interception of brackish flow into the new Marina may help the water quality within the Harbor, it is also the source of inflow to the anchialine ponds west of the proposed new Marina and the quantity of water intercepted could impact the salinity of these ponds significantly, changing the ecology of these systems (Ziemann, 2006). Note also that the increase in brackish groundwater inflow to the Harbor system will increase the quantity of brackish water leaving the system at the harbor mouth, which could have impacts on the salinity of the surrounding areas. In particular, examining the salinity profiles obtained from the model simulations at station J (OI Consultants, 1991) shows that largest differences in salinity are observed at the surface; the differences are less than 1 ppt for the 60 mgd groundwater brackish inflow into the new Marina (Figure 5-5 through Figure 5-9). As brackish inflow increases into the Honokohau/Kona Kai Ola system, the layer at the surface outside of the Harbor becomes less dense. In addition, the position of the exhibit discharge influences the salinity at the surface outside of the harbor. When the exhibit discharge is positioned at the back of Honokohau Harbor the salinity in the surface layers is higher. The lowest salinity occurs when an exhibit discharge is not included at any location.

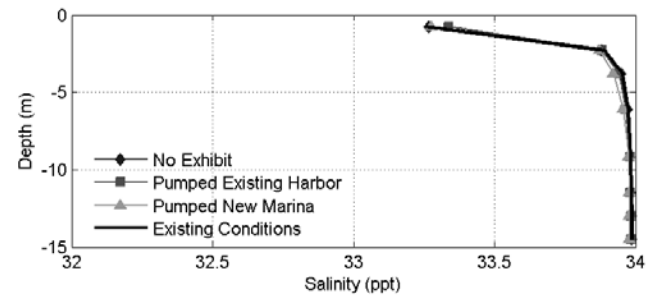

Figure 5-5: Salinity profile at station J (OI Consultants, 1991) for 0 mgd brackish inflow

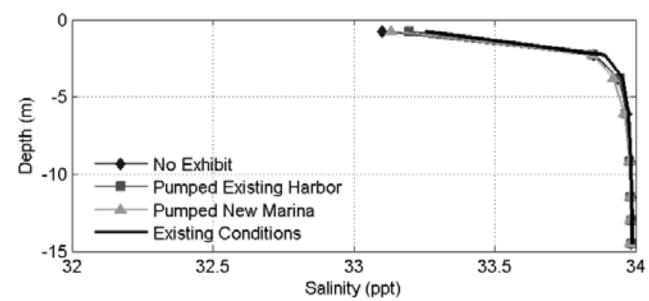

Figure 5-6: Salinity profile at station J (OI Consultants, 1991) for 10 mgd brackish inflow

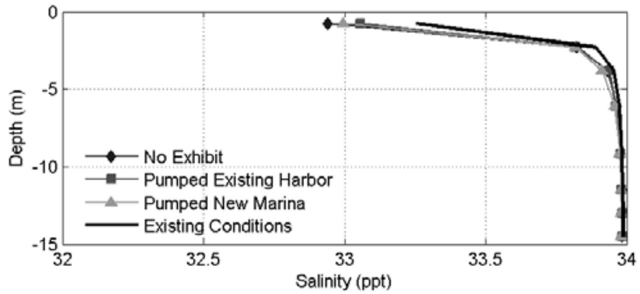

Figure 5-7: Salinity profile at station J (OI Consultants, 1991) for 20 mgd brackish inflow

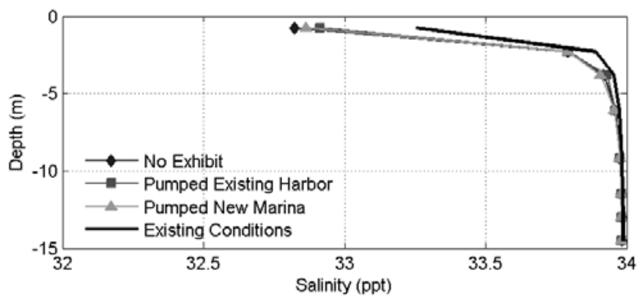

Figure 5-8: Salinity profile at station J (OI Consultants, 1991) for 30 mgd brackish inflow

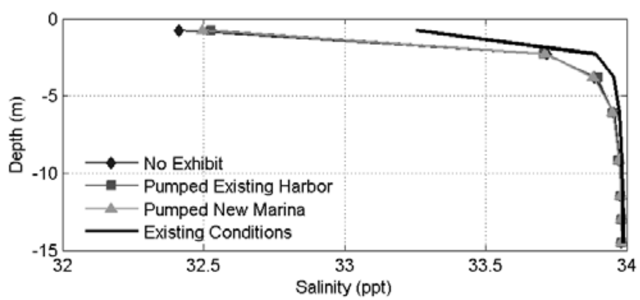

Figure 5-9: Salinity profile at station J (OI Consultants, 1991) for 60 mgd brackish inflow

5.4 Nutrients

Nutrient loads into the proposed new Marina are extremely dependent on the brackish water inflow. Since this quantity is unknown but has been bracketed into "reasonable" values for these simulations, it is difficult to determine exactly what the final nutrient profile will be within the proposed system. Because present conditions within Honokohau Harbor will be affected by the construction of the new Marina, it is beneficial to examine these effects in a broad manner. The two conditions that are available for comparison are the present conditions within Honokohau Harbor and the guidelines set by the state of Hawaii for water quality in the region. The following sections will describe the standards and classifications set, the future conditions that are typically expected within the Marina systems and the typical conditions that are expected immediately outside the Harbor mouth. Nutrient concentrations along the coastline of the Kaloko-Honokohau National Historical Park will be examined in a later section for selected scenarios.

5.4.1 Hawaii State Standards

Water quality standards for the state of Hawaii are described in Chapter 54 of the Hawaii revised statues (Department of Health, 2004). Water quality standards for the state of Hawaii designate Honokohau Harbor as Class A recreational area. The waters surrounding Honokohau Harbor are designated as Class AA pristine waters with stricter standards. It is therefore necessary to determine whether the existing Harbor is currently meeting the water quality standards and to determine whether the new Marina will create worse conditions with respect to standards in the area. Table 5-3 presents the Hawaii water quality standards; the values reported are geometric means for wet conditions. This assumes that additional, non-tidal inflow to the Harbor consists of greater than 1% of the total volume of the Harbor, which is the specification for Class A waters. The State also mandates exceedance criteria for the areas; however due to the assumption of typical conditions for the model, these criteria cannot be analyzed.

Table 5-3: Hawaii water quality standards

	Class A	Class AA
Ammonia-nitrogen (NH_4-N)	6 µg-N/L	3.5 µg-N/L
Nitrate-nitrogen (NO_3-N)	8 µg-N/L	5 µg-N/L
Total Phosphorous (PO_4-P)	25 µg-P/L	20 µg-P/L
Chlorophyll a (CHLa)	1.5 µg-Chla/L	0.3 µg-Chla/L

5.4.2 Nutrients within Honokohau Harbor and Kona Kai Ola Marina

For the purposes of this brief analysis of alternative performance, it was necessary to develop a mean value that represents the Harbors rather than describing the spatial and temporal variability. The spatial attributes of a select number of cases are described at length in a later section. For these purposes, all values were tidally averaged over the representative period after the model reaches a quasi-steady state solution and were then averaged over depth and space for both the Honokohau Harbor and Kona Kai Ola Marina. These areas are delineated in Figure 5-10. In this figure, the overlapping region between Kona Kai Ola Marina and Honokohau Harbor near the Harbor entrance is spatially averaged into both regions.

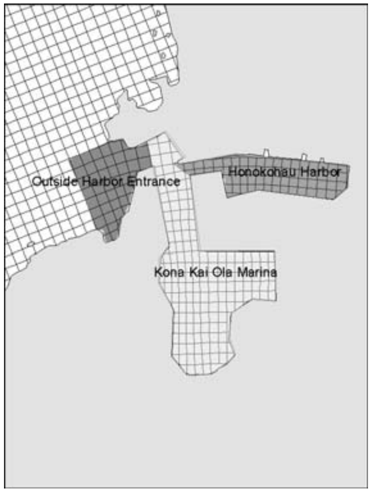

Figure 5-10: Locations of spatial averaging

These values do not represent variability related to seasonal tidal cycles or any seasonal effects. They are merely used as a gauge for measuring the changes in water quality associated to the different simulated scenarios.

Nitrate-nitrogen (NO_3-N)

The average nitrate-nitrogen values within Honokohau Harbor and the 400 slip Kona Kai Ola Marina are shown in Figure 5-11. It can be seen that even under existing conditions, the NO_3-N concentrations are not within the Hawaii standards for Class A waters. The 400 slip harbor shows NO_3-N concentrations increasing in a nearly linear trend as the quantity of brackish groundwater increases. Levels in the existing Harbor are highest for the cases where the exhibit water is pumped into the existing Harbor since this water is high in NH_4-N which is then nitrified into nitrate. In addition, the shorter flushing time that occurs in the Harbor with the added exhibit flows does not allow for as much algae growth and nutrient utilization, leaving the water column concentrations higher than in the other scenarios. The nitrate levels within the new Marina tend to be lower than the levels in the existing Harbor. This is due to the fact that the volume of the new Marina is larger than that of the existing Harbor which dilutes the nutrient concentrations in brackish groundwater inflows.

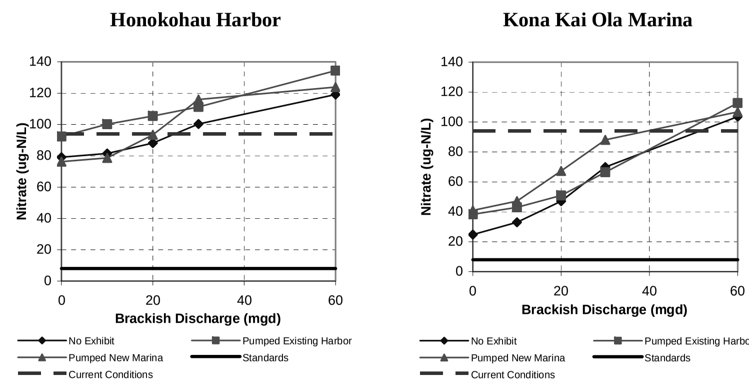

Figure 5-11: Nitrate-nitrogen (NO_3-N) conditions within Honokohau Harbor and 400 slip Kona Kai Ola Marina

Ortho-Phosphate(o-P)

Ortho-phosphate concentrations for Honokohau Harbor and the 400 slip Kona Kai Ola Marina are shown in Figure 5-12. These concentrations show a near linear trend similar to the concentrations of NO_3-N within the two harbors. Existing conditions show concentrations within the Hawaii standards for Class A waters. The proposed Marina does not increase the levels significantly for existing conditions and even in low brackish groundwater conditions, it results in a lowering of the ortho-phosphate concentrations.

Ammonia-nitrogen (NH_4-N)

NH_4-N values within the existing and new Marinas are shown in Figure 5-13. It is obvious that pumping the exhibit discharge with high NH_4-N concentrations into the existing Harbor significantly affects the ammonium concentrations in the existing harbor, exceeding the Hawaii state standards by almost 10 µg-N/L. This effect is also present in the new Marina when the exhibit flow is pumped into the back wall. The ammonia concentrations increase by about 6 µg-N/L also driving them above Hawaii state standards, although the effect is not as pronounced as that which occurs within Honokohau Harbor mainly because the larger volume of Kona Kai Ola Marina dilutes the concentrations to lower values within the new Marina.

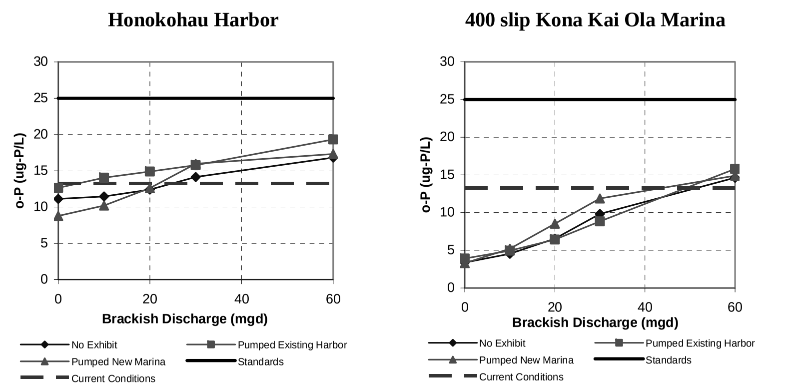

Figure 5-12: Ortho-phosphate (o-P) concentrations within Honokohau Harbor and 400 slip Kona Kai Ola Marina

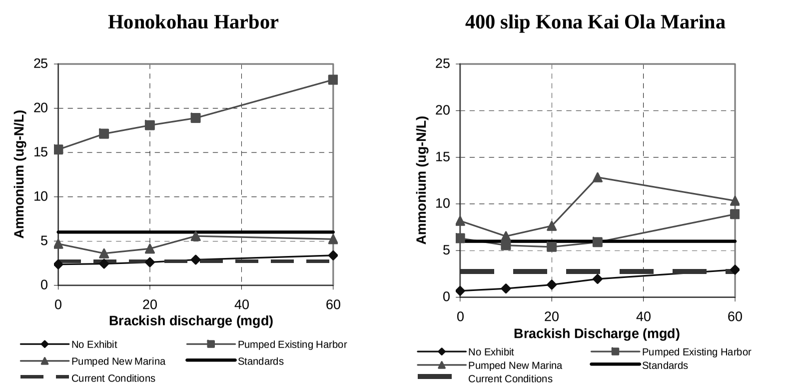

Figure 5-13: Ammonium-nitrogen (NH_4-N) concentration within Honokohau Harbor and 400 slip Kona Kai Ola Marina

<u>*Chlorophyll a (CHLa)*</u>

The Chlorophyll a values within the existing and new Marinas were computed based on the kinetic and physical dynamics of the system. It was found that decreasing the size of the new Marina was beneficial in controlling the excessive algae growth that was found to be problematic under the proposed 800 slip Marina. Under the groundwater inflow ranges modeled, it is found

that the smaller new Marina remains below approximately 3 µg-chla/L for all solutions (Figure 5-14). This indicates that both Marinas will exist in an oligotrophic state under typical conditions. In order to reach the Hawaii Class A standards that are set for Honokohau Harbor, a number of different scenarios were tested. It was found that with high levels of brackish water inflow, the harbors are more likely to be close to or below the Class A standards. The algae growth within the existing Harbor is severely limited when the exhibit flow is pumped into the back of this harbor. This indicates that this would be the best scenario to maintain the water quality within Honokohau Harbor. Pumping the exhibit flow into the back of the new Marina also benefits the existing Harbor, but the effect is not enough to lower Chlorophyll a concentrations to existing levels. With the cases corresponding to the mid-inflow values (20-30 mgd, which is similar to the inflow into the existing Harbor), brackish groundwater inflows into the new Marina show a significant decrease of Chlorophyll a concentrations at the Marina where the exhibit water is discharged.

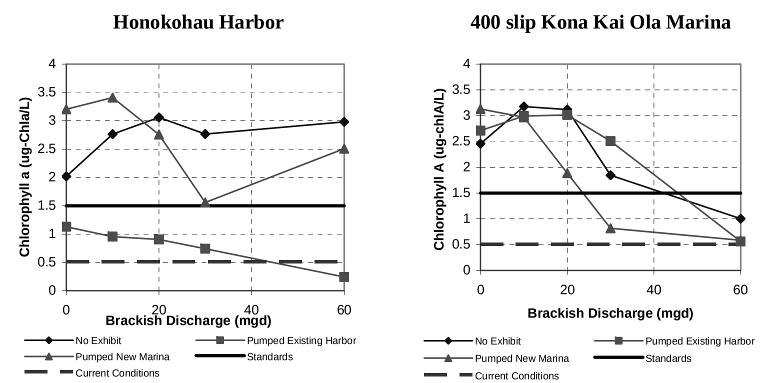

Figure 5-14: Chlorophyll a concentrations within Honokohau Harbor and 400 slip Kona Kai Ola Marina

It can be seen from the above analysis that simulations when the brackish groundwater flow into the new Marina are in the order or greater than 30 mgd, provide conditions that are approaching or within water quality standards for Class A waters. In addition flushing under these conditions appear to control the eutrophying potential of the high nutrient loads coming in from the brackish groundwater. These brackish groundwater inflow conditions seems to be possible based on the expert opinion of Waimea Water Services (2007) who states that it is likely that the construction of Kona Kai Ola Marina will likely intercept significant brackish groundwater post-expansion. In addition, it is expected that if the inflow of brackish groundwater is even higher than was tested, the flushing will be even more pronounced and the water quality conditions could be even better.

Another important observation is the influence of the exhibit water entering the marina. The exhibit water does not seem to affect the growth of algae except in its relationship to the flushing of the Harbor and Marina. Due to the nutrient limitations discussed in the following section, the additional nitrogen load does not cause additional algae growth, however it does cause increased ammonia and nitrate loads. It is expected that if this load is reduced, the exhibit inflow will have a beneficial additional flushing effect and at the same time it will not affect algae growth.

Nutrient Limitation

The limiting nutrient within the new and current system was found to be ortho-phosphate. This was tested in two ways. Among all the simulated cases, there are scenarios that contain “extra” nitrogen from the exhibit flow without additional phosphorous concentration. If the system were to be nitrogen limiting, this addition of available nitrogen to the system would cause additional algae growth. However, as is seen in the above section, the Chlorophyll a production with the addition of the exhibit flow is minimal at best. In addition, in other sensitivity tests, the phosphorous concentration in the brackish inflow was increased arbitrarily by a factor of two to determine if this would cause additional algae growth. In fact, the chlorophyll production increased significantly with the addition of extra ortho-phosphate, which corroborates the phosphorous limitation discussed in Section 4.8.1.

This determination is important as it signifies the impact of additional phosphorous loads on the system and the need to monitor those loads extremely carefully to maintain the water quality within the system.

5.4.3 Nutrients immediately outside Harbor Entrance

The area immediately surrounding the harbor mouth is examined in OI Consultants (1991). This area was examined for all the simulated cases in order to determine the effect that the new Harbor system has on the water quality conditions at the immediate surrounding waters. This area is also shown in Figure 5-10. Similarly to the analysis performed for Honokohau Harbor and Kona Kai Ola Marina, the model results at the selected location outside of the Harbor entrance were tidally averaged over the representative period after the model spin-up period and were then averaged over depth.

Nitrate-nitrogen (NO_3-N)

The average nitrate-nitrogen values outside of the Harbor entrance are shown in Figure 5-15. It can be seen that even under existing conditions, the nitrate-nitrogen levels exceed the Hawaii standards for Class AA waters. Nitrate levels increase in a nearly linear trend with the groundwater brackish inflow into the new Marina. Nitrate concentrations are higher when the exhibit water is pumped into the Marina system since this water is high in ammonia which is then nitrified into nitrate. In general, nitrate concentrations after the new Marina construction are expected to be in the same order to those observed under existing conditions.

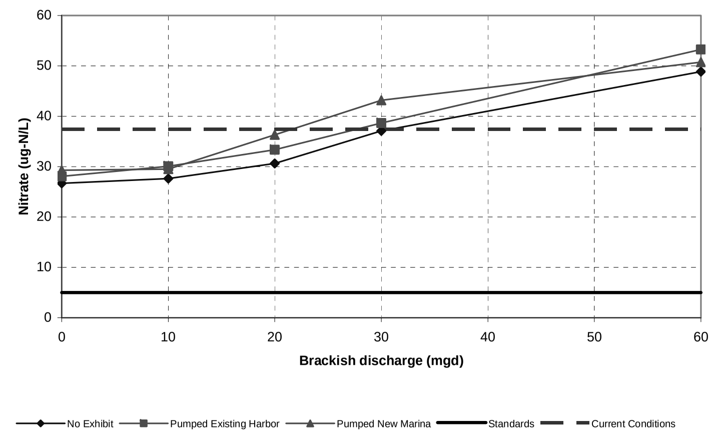

Figure 5-15: Nitrate-nitrogen concentrations outside Harbor entrance

Ortho-Phosphate (o-P)

Ortho-phosphate levels outside of the harbor entrance are shown in Figure 5-16. These concentrations show a near linear trend similar to the values of nitrate outside of the Harbor entrance. Existing conditions show concentrations within the Hawaii standards for Class AA waters. The proposed Marina does not increase the levels significantly from existing conditions and even in low groundwater brackish inflow, it results in a lowering of the ortho-phosphate levels.

Ammonium-nitrogen (NH_4-N)

NH_4-N levels outside of the Harbor are shown in Figure 5-17. This shows that NH_4-N concentrations are noticeably increased by including the exhibit flow, however still meet the Hawaii state standards. The influence of the exhibit flow is most pronounced outside of the harbor when it is pumped into the existing Harbor.

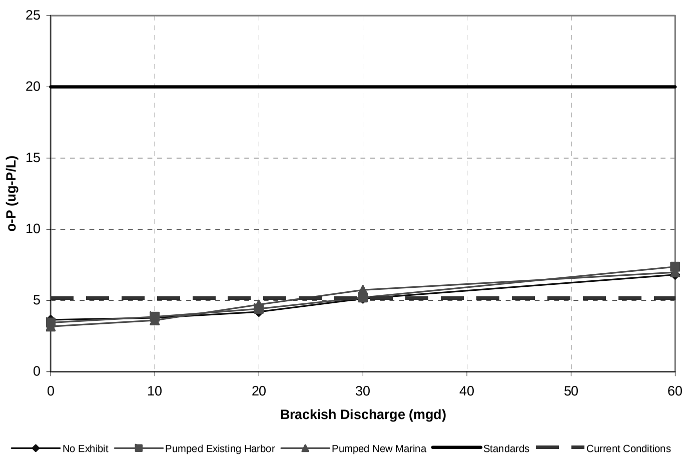

Figure 5-16: Ortho-phosphate conditions outside Harbor entrance

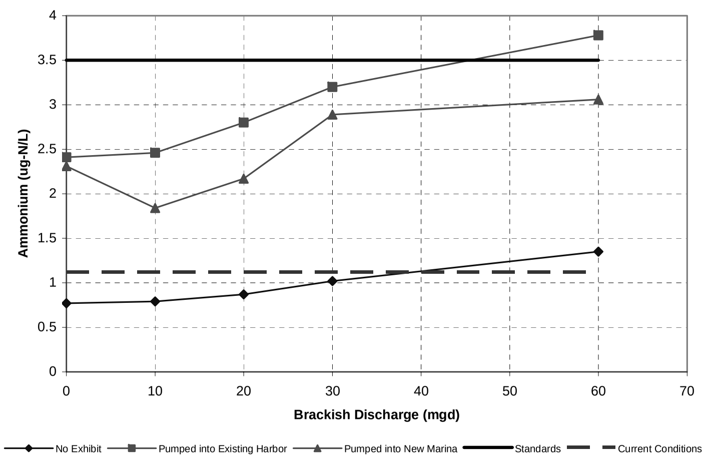

Figure 5-17: Ammonium conditions outside of the Harbor entrance

<u>*Chlorophyll a*</u>

Immediately outside the Harbor entrance, the Chlorophyll a values are mainly confined to the surface layers of the system for all scenarios. Figure 5-18 shows the tidally and depth averaged values for the area just outside of the Harbor. These values appear to consistently exceed Class AA standards shown in Table 5-3; however they all fall below the standards for Class A waters (Table 5-3). Due to the area's proximity to the Harbor entrance, this may still remain acceptable as long as the algae dies and is diluted within a reasonable distance from the Harbor mouth. This is examined in more detail in Section 6.

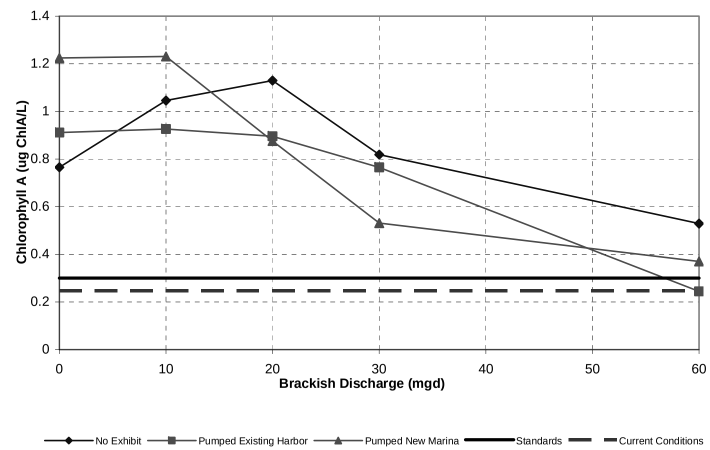

Figure 5-18: Chlorophyll a values outside the Harbor entrance

5.5 Detailed Description of Two Alternatives

From all the simulated alternatives, two were selected for further discussion. In order to select these two cases, the following conclusions from the model results were considered:

- While the cases pumping the exhibit flow into the existing Marina provided overall better water quality results, it may be considered not advantageous to further impact the conditions of Honokohau Harbor.
- Since the addition of the large quantity of water from the exhibits does have slightly beneficial results in terms of flushing time and the excess nitrogen does not affect the water quality due to the phosphorous limitation, cases including the exhibit flow in the new Marina were selected.
- Since the brackish water inflow is an unknown quantity, one reasonable assumption is that the same amount of water that is intercepted by the existing Harbor could also be intercepted by the new Marina. Therefore, the 30 mgd case was selected as the most reasonable case with beneficial results.

- In addition, the case containing 0 mgd of brackish groundwater is also analyzed as a bounding case, since this condition appears to cause some of the worst algae production. It is worth noting that although the case with 0 mgd of brackish inflow does allow significant algae growth, all the cases analyzed with a 400 slip marina create oligotrophic conditions in both new and existing Marinas, while some cases analyzed with the 800 slip marina led to eutrophic conditions.

5.5.1 *Case 1: 400 slip New Marina, 0 mgd brackish groundwater inflow, exhibit flow pumped into new Marina*

Currents

The velocity structure under this alternative that is without brackish groundwater into the new Marina is similar to the conditions observed with the 800 slip Harbor. Density currents are not generated within the new Marina due to the lack of brackish groundwater inflow. Therefore, internal circulation between the two harbors remains problematic as in the 800 slip case. The new Marina still shows a top layer moving towards the back of the new Marina from the existing Harbor (Figure 5-19) and a bottom layer moving out towards the ocean. The back end of the new Marina is defined at 0 m. This internal circulation prevents the two-layer "pumping" observed under existing conditions in Honokohau Harbor. It therefore increases the flushing time, which is 25 hours in this scenario, and leads to build up and growth of algae within the system.

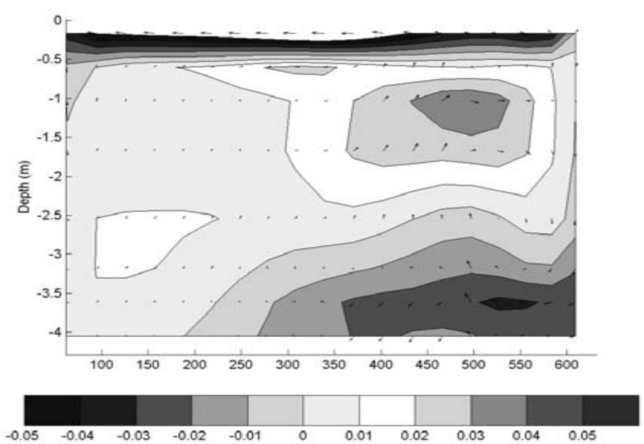

Figure 5-19: Velocities at peak flood (m/s) along Transect NM (Figure 3-12) for Case 1

At the Harbor mouth the depth distribution of velocities is similar to those shown in Sections 3.2.6 and 3.3.5. The profiles shown in Figure 5-20 are at the location specified in Figure 3-12. It is seen that during ebb tide for this scenario, there is no water entering from the ocean at the bottom layer, which could also impact the amount of flushing that is occurring.

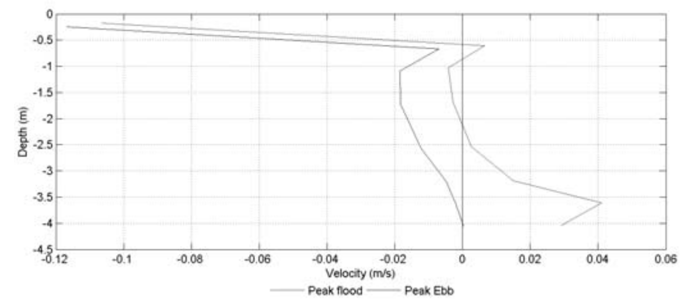

Figure 5-20: Velocity profiles at harbor entrance (Figure 3-12) for a brackish inflow of 0 mgd and a 400 slip new Marina

Salinity

The salinity patterns within the existing Harbor retain a similar structure to those found under existing conditions, as there are not any density changes in the new Marina to affect the structure in the existing Harbor (Figure 5-21 and Figure 5-21). However, in the surface layers towards the ocean side of the Harbor, the water is slightly more saline due to the fact that the low salinity water is entering the new Marina and is not all continuing out in the surface layers to the ocean.

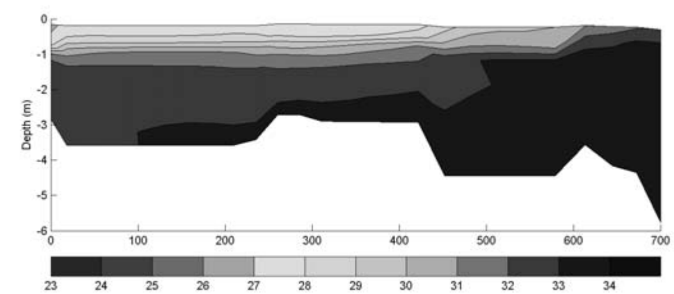

Figure 5-21: Salinity at peak flood (ppt) along Transect EH (Figure 3-12) at high tide for Case 1

The salinity contours within the new Marina show that the main body of water within the new Marina is highly saline (Figure 5-22). Only a small amount of brackish water found at the surface near the intersection of the two harbors is present. This brackish water is moving toward the back of the new Marina as shown in the previous section.

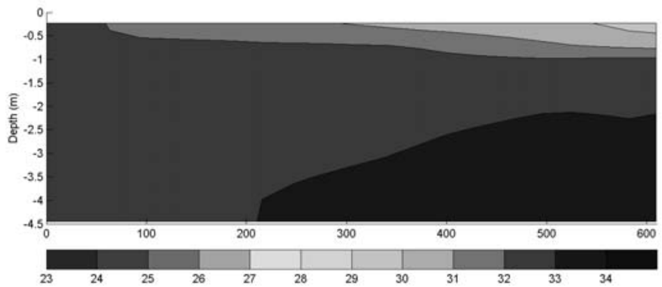

Figure 5-22: Salinity contours at peak flood (ppt) along Transect NM (Figure 3-12) for Case 1

<u>Chlorophyll a</u>

Chlorophyll a concentrations within the existing Harbor at high tide are shown in Figure 5-23. These values are fairly high at the back of the existing harbor. They retain the same depth trend as is shown under existing conditions. The chlorophyll a concentrations within the Harbor range from 2 to 5 µg-Chla/L. The mean value that was reported in Section 5.4.2 was 3 µg-Chla/L; however, spatial and depth variability is great. Under existing conditions, the high value was about 0.5 µg-Chla/L.; thus, the degradation of the water quality under these conditions is apparent even with the smaller proposed 400 slip Marina.

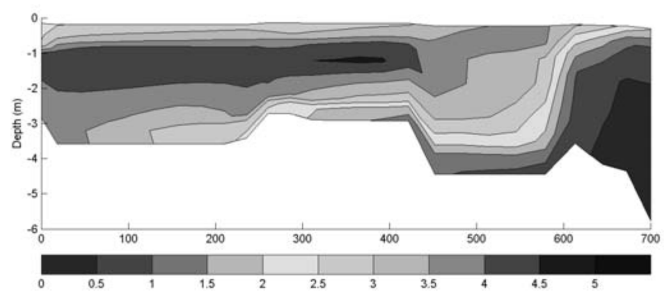

Figure 5-23: Chlorophyll a concentrations at peak flood along Transect EH (Figure 3-12) for Case 1

Within the new Marina, Chlorophyll a concentrations are high in the surface layers toward the middle of the new Marina (Figure 5-30). The nutrients for the algae consumption and reproduction enter the new Marina at the surface layer (coming from the existing Harbor). The algae resist growing near the intersection of the two harbors because the water at the surface is brackish and the more saline environment near the middle of the Marina is favored. Near the back wall, the discharge from the exhibit contains minimal Chlorophyll a concentrations; therefore this area near the wall does not promote as much algae growth.

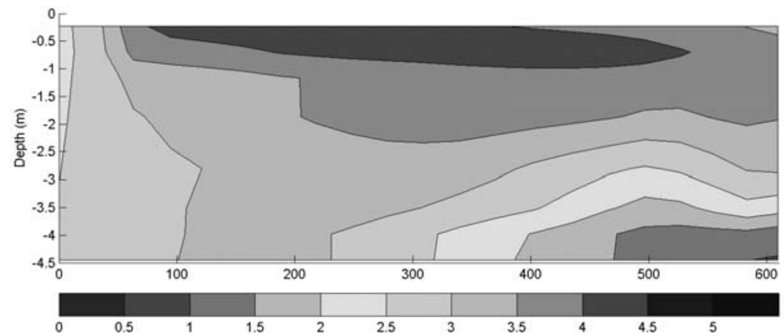

Figure 5-24: Chlorophyll a concentrations at peak flood (µg-chla/L) along Transect NM (Figure 3-12) for Case 1

5.5.2 Case 2: 400 slip new Marina, 30 mgd brackish groundwater inflow, exhibit flow pumped into new Marina.

<u>Currents</u>

The velocity structure with 30 mgd of brackish groundwater flowing into the new Marina develops into more defined (relative to Case 1) two layer structure and exhibits much higher velocities flowing out of the new Marina than were observed in Case 1 (Figure 5-25). This indicates that the new Marina is developing a density current system similar to what is observed under existing conditions in Honokohau Harbor. This is also observed in the flushing time of the new Marina which is shown to have decreased to about 13 hours from the 25 hours observed in Case 1. This is an indicator that overall water quality will be significantly improved within the new Marina, as it is starting to draw in ocean water at higher velocities and push out water in the middle layers at faster velocities.

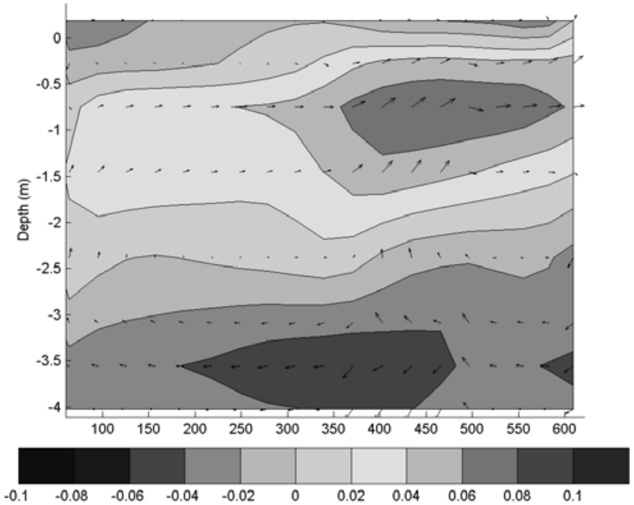

Figure 5-25: Velocities at peak flood (m/s) along Transect NM (Figure 3-12) for Case 2

At the harbor entrance, the velocity profiles at peak flood and peak ebb look similar to those shown in Sections 3.2.6 and 3.3.5; however it should be noted that there is a recurrent inflection in the velocity profiles that is directed out of the Harbor at about 1 to 2 m of depth (Figure 5-26). This is due to the flow that exits the new Marina below the surface layer. This layer also appears to always be directed out of the Harbor during both flood and ebb tide. During peak ebb, there is still flow entering the Harbor system at the bottom layer; however the velocities are not as high as those under existing conditions. This among other factors may contribute to the degradation of the water quality within the existing Harbor.

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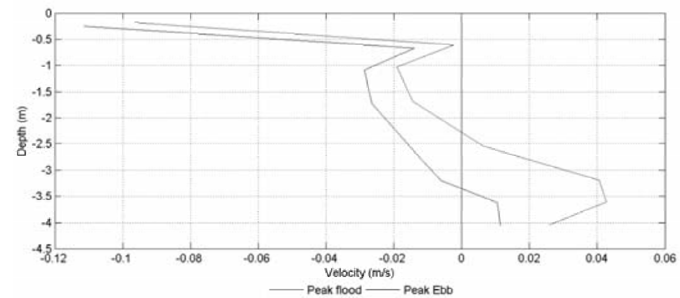

Figure 5-26: Velocity profiles at harbor entrance for a brackish inflow of 0 mgd and a 400 slip new Marina

<u>*Salinity*</u>

The salinity profiles within the existing Harbor appear similar to those shown in Figure 3-18. It is of note that the salinity in the back end of the existing Harbor is slightly more brackish (Figure 5-27), and that the contours extend further down in the water column. This is of note because it indicates that the nutrient-laden brackish water that under existing conditions is confined to the surface water is mixed into the lower layers, creating a more suitable environment for algae growth.

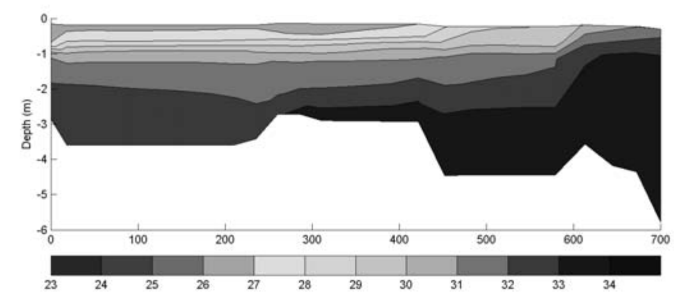

Figure 5-27: Salinity at peak flood (ppt) along Transect EH (Figure 3-12) at high tide for 0 mgd brackish water inflow and 400 slip new Marina

Salinity within the new Marina is much more stratified than in Case 1. This induces more density driven flows into and out of the new Marina.

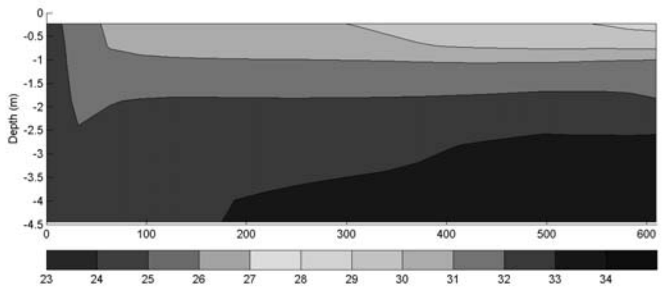

Figure 5-28: Salinity contours at peak flood (ppt) along Transect NM (Figure 3-12) for Case 2.

Chlorophyll a

Within the existing Harbor, there is a wide range of Chlorophyll a concentrations. While the value reported as the mean value for the entire Harbor was 1.5 µg-chla/L, it is seen in Figure 5-29 that the values within the existing Harbor range from almost zero to almost 4 µg-chla/L. However, it is also noted that this range is much more variable and tends to be lower than that found in Case 1. This indicates that more of the nutrients and algae are moved out of the system. It still appears that not enough ocean water is pumped through the system. This is evidenced by the lower salinities in the deeper parts of the back basin. More nutrients are remaining in the system, and the algae growth in the back of the existing Harbor is higher than in the rest of the system. It was also shown in previous sections that pumping the saline exhibit water into the existing Harbor also significantly increases the mixing within this Harbor.

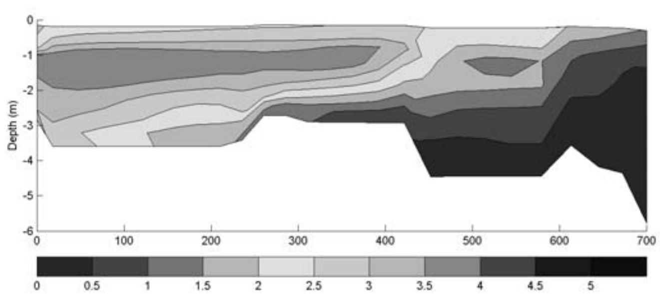

Figure 5-29: Chlorophyll a concentrations at peak flood (µg-chla/L) along Transect EH (Figure 3-12) for Case 2.

Chlorophyll a concentrations within the new Marina are very low, with only slightly higher concentrations near the intersection of the existing Harbor (Figure 5-30). This indicates that 30 mgd of brackish water appears to be significant enough to flush this marina adequately enough to prevent significant algae growth. It also indicates that the new Marina may be intercepting more ocean water that is drawn into the existing harbor under existing conditions.

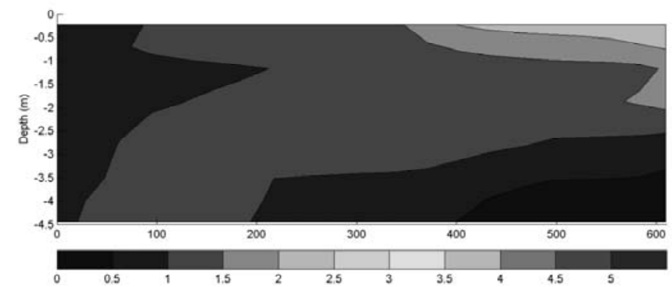

Figure 5-30 Chlorophyll a concentrations at peak flood (µg-chla/L) along Transect NM (Figure 3-12) for 0 mgd brackish water in 400 slip Marina

6. EFFECT ON SURROUNDING COASTLINE

The hydrodynamic and water quality model described in Chapters 3 and 4 was developed and calibrated to reproduce existing conditions in the Honokohau Harbor and future conditions in the new Marina system. Although the model reproduces the velocities and water level variation under tidal conditions at Honokohau Bay, it has not been calibrated to reproduce accurately the salinity distribution or water quality in that area. Water quality model calibration at Honokohau Bay was not considered part of this study mainly due to the scarcity of oceanographic and water quality data and most importantly the unavailability of data regarding groundwater brackish water inflows into the ponds and through the coastline and anchialine ponds. In order to calibrate the water quality model including Honokohau Bay, a comprehensive data collection effort together with a thorough groundwater study would be necessary.

Because the coastal area north of Honokohau Harbor (Honokohau Bay) is important due to its coral populations as well as its proximity to Kaloko-Honokohau National Historical Park and its existing pristine natural state under the state's Class AA designation, the numerical model has been used to estimate possible changes from existing water quality conditions in Honokohau Bay due to the development. The nutrient concentrations in this region are important to the National Park Service and it is necessary that nutrient concentrations within the region conform to state standards for the Class AA pristine climate that exists currently. Note that results presented in this section should be used with caution. They provide an approximate measure of relative changes in water quality conditions caused by the new marina development.

Due to the previously explained limitations in model predictability, the effect of the new development in the water quality of the surrounding coastal areas cannot be estimated in absolute terms from the simulations, as the water quality model was not calibrated for these areas. As it was already mentioned, determining the quantity and quality of the groundwater discharged at specific locations along this coastline was beyond the scope of the study, and while coastal groundwater brackish inflows along the coastline were included, their amounts and also nutrient concentrations were approximated and not directly observed. Therefore, the changes that occur at neighboring areas of Honokohau Bay due to the introduction of the proposed Kona Kai Ola Marina are represented as relative changes from the existing conditions. For all sections and comparisons, plots are provided showing the relative difference (termed *Diff*) in concentration from existing conditions, be it a negative or positive difference. This was calculated using the tidally average mean value of the concentration, C_a, such that,

$$Diff = \left(C_{avNEW} - C_{avEXIST}\right)/C_{avEXIST}$$

The scenarios tested were compared in the previous section in the area just outside of the Harbor entrance to examine how the nutrients are diluted in this region. Both surface changes and bottom changes are shown in order to demonstrate the stratification of the system and the effects on the benthic and coral populations. Due to the fact that the large 800-slip marina results in significant water quality degradation, the analysis of the offshore effects is neglected for this alternative.

6.1 Depth Averaged Velocity

Bilger and Atkinson (1995) state that the nutrient uptake rate of a coral reef population is related to the velocity near the bed. Therefore, examining the impact of the proposed marina on velocities through the entrance channel of the Harbor is necessary.

In order to examine the effects of the proposed Marina on the nutrient uptake rate, the relative increase in velocities in the offshore region of coral populations were analyzed. The existing depth averaged velocity magnitudes in this region are shown in Figure 6-1. The changes associated to the additional marina are three-fold. First, there is an increase in tidal prism due to the expanded volume, which increases the flow through the Harbor entrance. Second, there is an unknown quantity of additional brackish groundwater that will be intercepted by the new Marina. Third, there is the potential of exhibit water discharge in the system. All of these effects serve to increase velocities through the entrance channel; however the simulated velocities remain relatively small

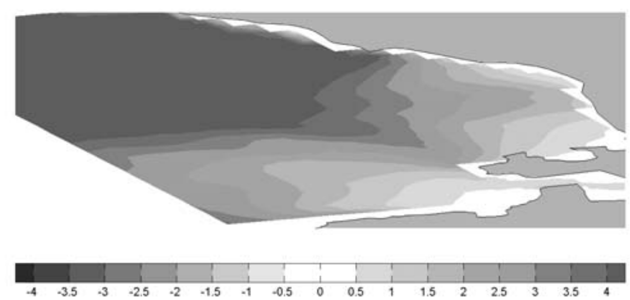

Figure 6-1: Depth averaged velocities (cm/s) under existing conditions

The increases are shown in Figure 6-2 for cases with exhibit flow included. It is shown that increases in depth averaged velocities are most pronounced in the Harbor mouth and dissipate quickly after exiting the Harbor. The figures in this section are based on relative differences. The numbers shown are meant to indicate fractional increase or decrease. The increase in velocity when including the exhibit flow is about 1.6 times the amount of the existing flow, so there is about a 1.6 cm/s increase in depth-averaged velocity through the entrance channel. This includes only the effects of the increased tidal prism and the additional exhibit water. When additional brackish inflow is accounted for, the depth-averaged velocities continue to increase by about 3 times the existing velocity, or 3 cm/s. This would result in depth-averaged velocities of about 4 cm/s through the entrance channel. It is noted that these velocities are influenced only by tidal and discharge effects. Velocity effects due to waves and oceanic currents could be fairly significant especially during seasonal events, in which case, the change due to the additional discharges and tidal prism would be less significant.

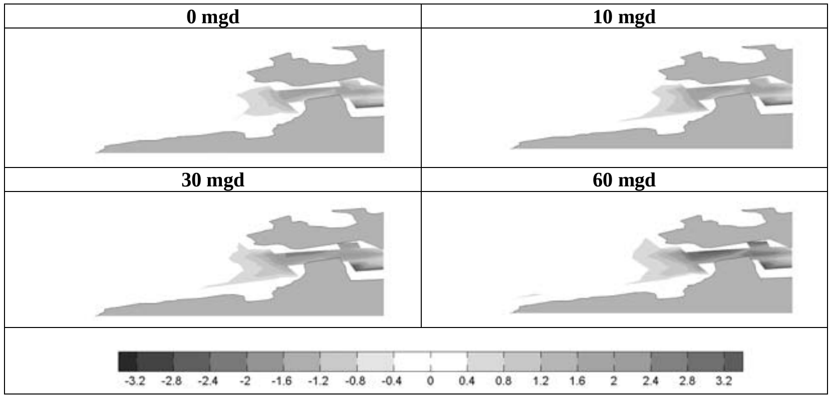

Figure 6-2: Relative increases in depth averaged velocity with exhibit water included

This increase in velocities is somewhat limited when the exhibit discharge is excluded (Figure 6-3); however the increased tidal prism and the additional brackish inflow continue to affect the velocities. In the case where there is not any additional brackish inflow and not any exhibit inflow, the increased tidal prism is the only factor affecting the velocities, and it appears that this effect alone causes an increase in depth-averaged velocity of about 0.8 to 1.2 cm/s (about 1x existing conditions higher velocities). However, it appears that when the exhibit water is excluded the effects on the depth-averaged velocities are more confined to the entrance channel and do not extend far from the Harbor mouth. This is likely to be important as it will control the surface area of coral that may be affected by the increased velocities.

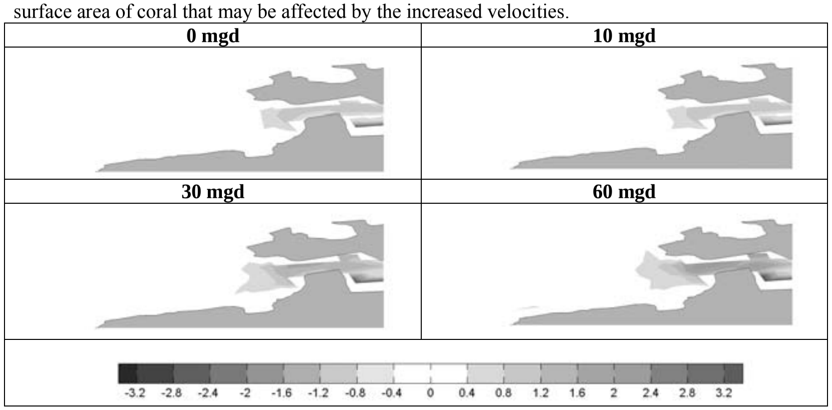

Figure 6-3: Relative differences in depth averaged velocity with exhibit water excluded

It is not possible to extrapolate exactly how the nutrient uptake rates in the area will be affected by the increased velocities. Bilger and Atkinson (1995) conducted their experiments in an extremely controlled environment, and they were more concerned with higher velocity flow (with tests starting at a minimum depth-averaged flow of 4 cm/s). This effect would have to be studied in more detail to get an accurate picture of the velocity effect on the coral in the area.

6.2 Salinity

The salinity of the waters outside of the Harbor changes by a very small amount both when the exhibit water is included in the model and when it is excluded. Figure 6-4 shows that for the cases with exhibit water included, the salinity at the surface exhibits changes that are very small when the amount of brackish groundwater entering the new Marina is small (<20 mgd). In the cases of 30 mgd and 60 mgd of brackish groundwater inflow, the system tends to become slightly fresher with almost a 4% decrease in salinity in the 60 mgd case.

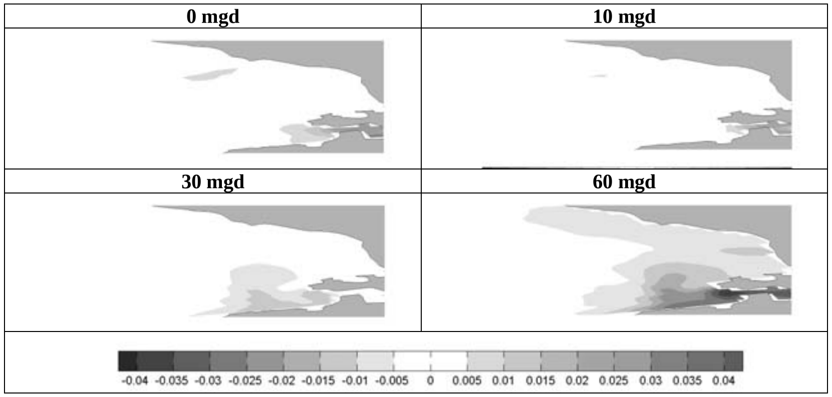

Figure 6-4: Relative salinity changes from existing (fraction) at the surface with exhibit flow included

Changes near the bottom outside the Harbor are even smaller, with maximum change being a reduction of about 1% along the shallow area of the Park coast at 60 mgd of brackish inflow. This indicates that the changes in salinity due to the brackish inflow are mainly confined to the surface layers, and that in the deeper waters away from the coast, the changes are extremely minimal near the bottom. This indicates that salinity conditions for the coral populations outside the harbor should remain similar to existing conditions post-expansion.

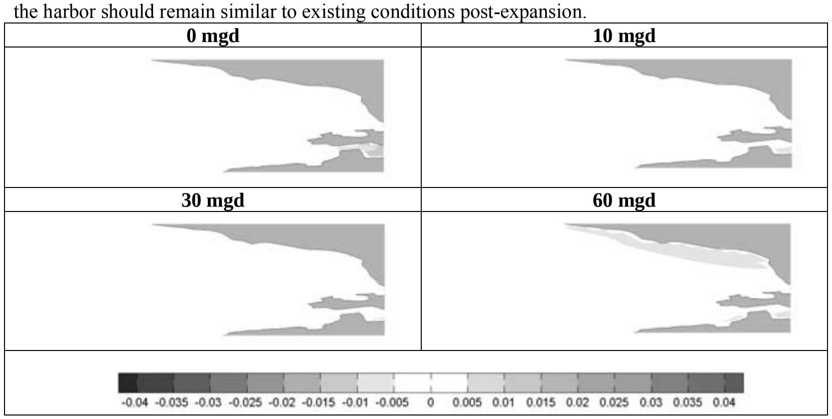

Figure 6-5: Relative salinity changes from existing (fraction) at the bottom with exhibit flow included

When the exhibit waters are excluded, the waters surrounding the Harbor show slightly more change than when the saline exhibit waters are included (Figure 6-6).

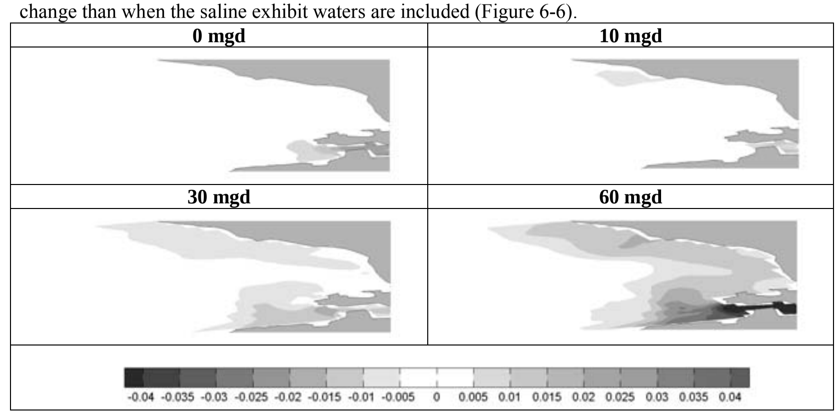

Figure 6-6: Relative salinity changes from existing (fraction) at the surface with exhibit flow excluded

For brevity, relative changes in salinity at the bottom with exhibit flow excluded are not displayed. Changes are within 0.005 ppt of existing conditions for all cases, indicating that changes in salinity are insignificant in the bottom layers without the exhibit inflow.

6.3 Nutrients

6.3.1 Nitrate-nitrogen

All nutrients (NO_3-N, o-P, and NH_4-N) follow similar trends in their exit from Honokohau Harbor; however, the levels of nitrate are most concerning, as the current conditions already exceed standards both within Honokohau Harbor and outside the Harbor. Figure 6-7 shows the relative additions to the nitrate-nitrogen concentrations in the vicinity of the Harbor when the exhibit outfall into the system is included. It shows that in the conditions with less brackish groundwater inflow, the concentrations in the vicinity of the National Park are less than current conditions. For the case with 30 mgd of additional brackish inflow, the concentrations are about 10 to 20 percent greater With 60 mgd, the concentrations can increase to 40 percent greater than current conditions. According to values reported by Ziemann in the area, nitrate-nitrogen concentrations range from about 300-900 µg-N/L at the surface. Therefore these increases of 10% are fairly small (<10 µg-N/L). It is worth noting that state standards mandate that Class A waters maintain a mean concentration of 8 µg-N/L.

Bottom concentrations follow similar trends (Figure 6-8) as the surface concentrations with concentrations decreasing with lower groundwater inflow, and increasing with higher groundwater inflow. The higher increases and decreases in concentration tend to be near the coastline of Kaloko-Honokohau National Historical Park. This is likely due to the shallow waters there which allow for nutrients confined to the surface layers mix into the bottom layers.

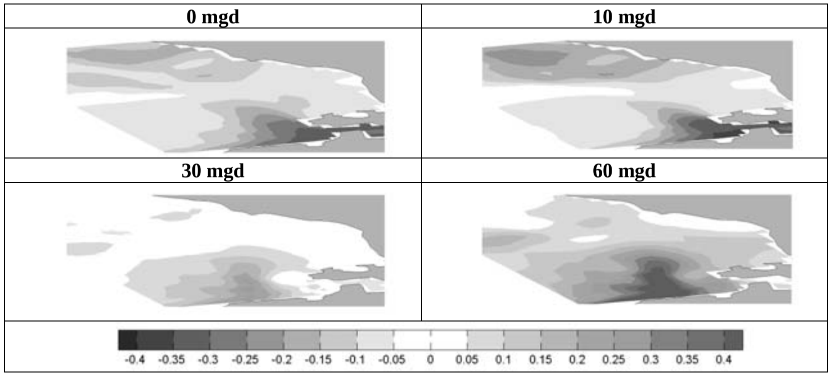

Figure 6-7: Relative additions in nitrate-nitrogen concentrations at the surface with exhibit flow included

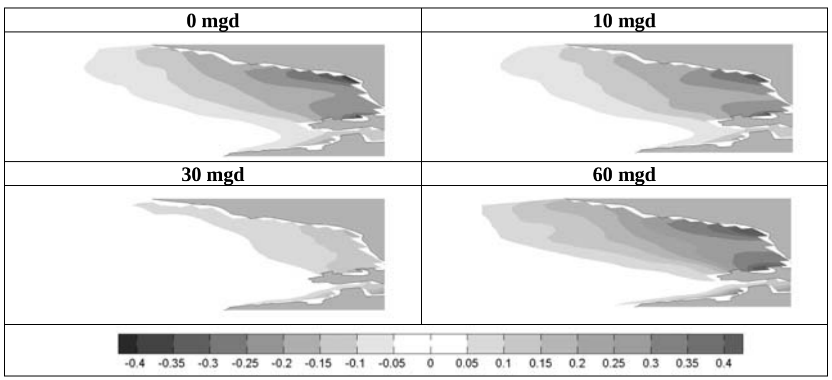

Figure 6-8: Relative additions in nitrate concentrations near the bottom with exhibit flow included

The outfall of the exhibit water into the marinas is shown to introduce a significant ammonia-nitrogen load to the system. This can also affect nitrate-nitrogen levels because in high oxygen environments, ammonia-nitrogen will convert to nitrate-nitrogen. This can be seen in Figure 6-9 and Figure 6-10, which show that concentrations outside the Harbor do not start to increase until 60 mgd of brackish groundwater are introduced to the system when the exhibit outfalls are excluded.

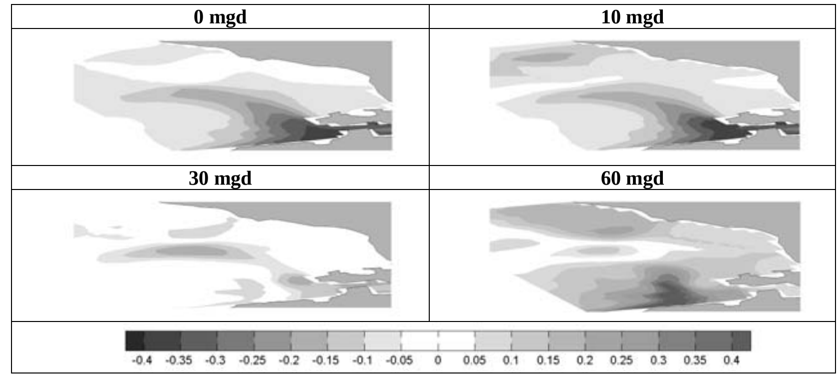

Figure 6-9: Relative additions in nitrate concentrations near the surface with exhibit flow excluded

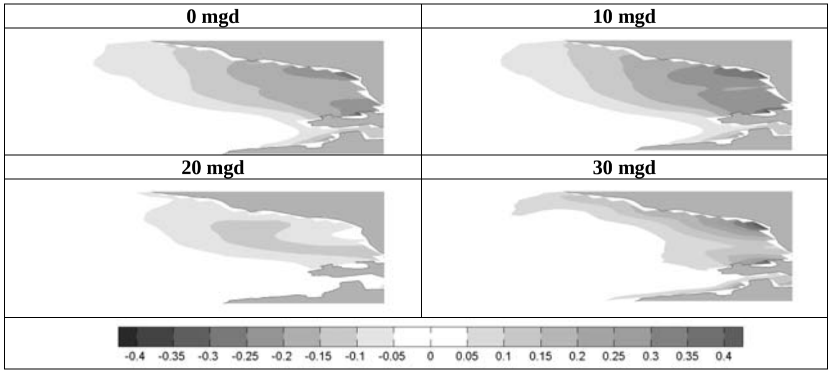

Figure 6-10: Relative additions in nitrate concentrations near the bottom with exhibit flow excluded

6.3.2 *Ammonia-nitrogen*

While the other nutrients are almost entirely dependent on the inflowing brackish groundwater, ammonia-nitrogen is introduced by the exhibit waters and is therefore more variable based on the alternative selected. Figure 6-11 shows the relative changes of ammonia-nitrogen outside of the Harbor at the surface with the inclusion of the exhibit flow. It is seen that in the surface waters, the highest impact occurs offshore of the Harbor, with fewer impacts near the Park coast.

Higher ammonia-nitrogen concentration levels are found in the cases with the greater amounts of brackish discharge at the surface occurs when the brackish water flowing from the new Marina is sufficiently light to mix with the ammonia from the exhibit waters and still flow out of the Marina.

The impacts in the near the bottom outside of the Harbor are more pronounced along the coast, with higher brackish discharge causing ammonia-nitrogen in the bottom layers. Also in these shallow areas, nutrients that are normally confined to the upper layers of the water column can potentially be mixed into lower layers in this region due to its shallow nature. As was shown in earlier sections, the Harbor flushing is faster when more brackish groundwater is intercepted, resulting in improved water quality. While this effect is beneficial for the Harbor waters, it results in a relative increase of nutrient loads on coastal waters increase when the water is flushed out of the Harbor.

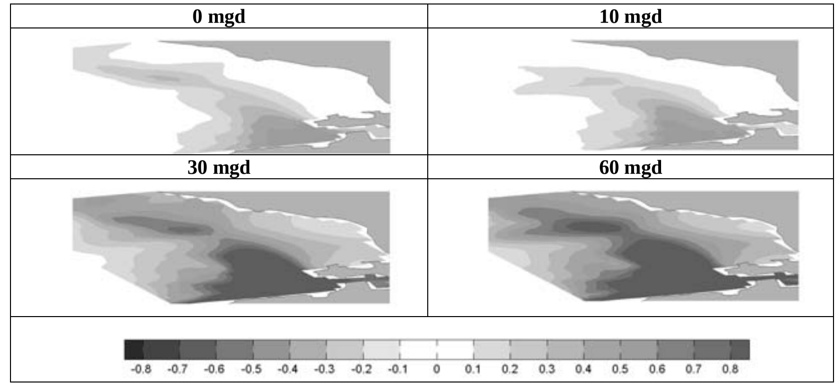

Figure 6-11: Relative ammonia-nitrogen changes from existing at the surface with exhibit flow included

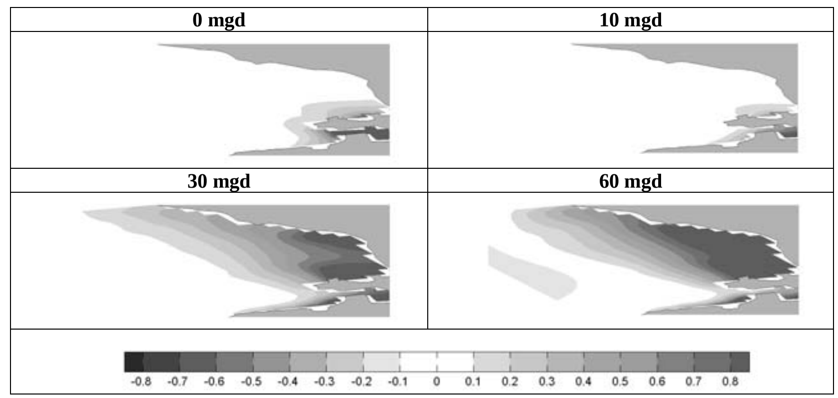

Figure 6-12: Relative ammonium-nitrogen changes from existing at the bottom with exhibit flow included

When the exhibit discharge is not considered as an input to the model, the results show that the trends of the ammonia-nitrogen concentrations follow what is shown with the nitrate-nitrogen concentrations. This is due to the fact that in this case, the main input of ammonia-nitrogen and nitrate-nitrogen is from the brackish groundwater. The results indicate that when exhibit water is not included, the relative increase is less than when exhibit water is included. This is important as the uptake of ammonia-nitrogen by coral is greatly influenced by the ambient concentrations in the bottom layer as well as the velocity effects discussed earlier.

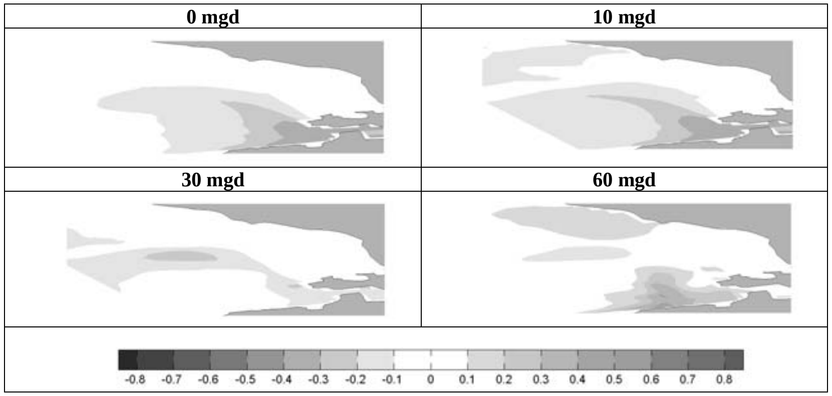

Figure 6-13: Relative ammonium-nitrogen changes from existing at the surface with exhibit inflow excluded

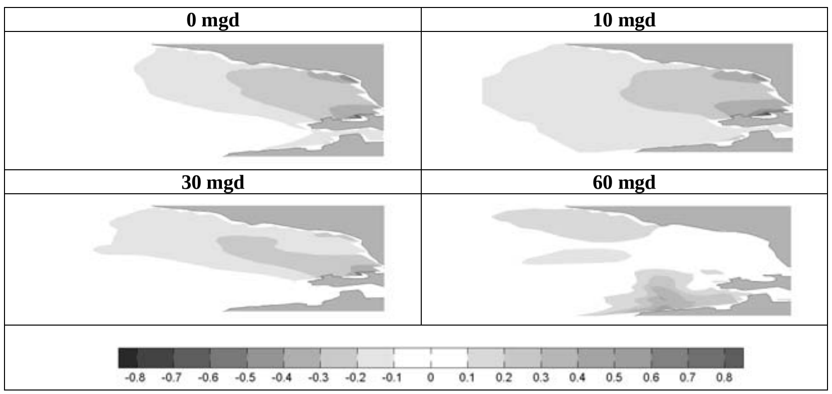

Figure 6-14: Relative ammonium-nitrogen changes from existing at the bottom with exhibit flow excluded

6.3.3 Chlorophyll a

Chlorophyll a concentrations along the coastline of Kaloko-Honokohau National Historical Park are of importance, as algal blooms and invasive algae species have been shown to be detrimental to benthic and coal communities. Current state standards mandate that concentrations within the

Honokohau Bay have a mean value less than 0.3 µg-chla/L. Ziemann (2006) reported chlorophyll levels along Transect B in the range of about 0.2 µg-Chla/L to about 1.5 µg/L, indicating that in this time period, Chlorophyll a concentrations were mainly above standards. Figure 6-15 and Figure 6-16 show the relative increase of the Chlorophyll a concentrations with the addition of the new Marina for the surface and bottom layers respectively. It is seen that surface concentrations increase much more dramatically than the bottom concentrations, especially when brackish groundwater is low and the marina system flushing is slow. This allows more algae to grow in the quiescent waters of the marinas before being released from the harbor mouth. As brackish inflow through the new Marina increases, the production of algae decreases due to the more rapid flushing out of the Harbor into more expansive waters. It can be seen that the concentration can increase by four-fold in some cases.

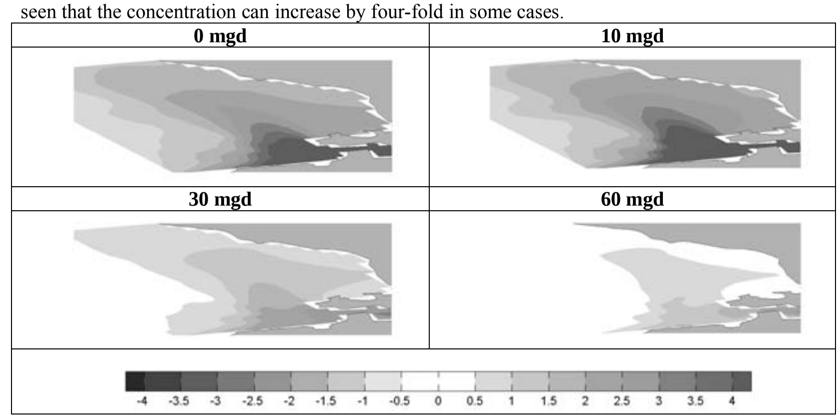

Figure 6-15: Relative increases in Chlorophyll a concentrations at the surface with exhibit inflow included

Concentrations in the bottom layers do not increase by the same relative amounts as the surface changes because of light restrictions and less available nutrients (Figure 6-16). However in the cases of lower brackish inflow, the increases can be on the order of the existing concentrations.

Simulation results indicate that when the exhibit water is not included (Figure 6-17 and Figure 6-18), the increase in Chlorophyll a production appears to be slightly higher than experienced with the diluting exhibit water.

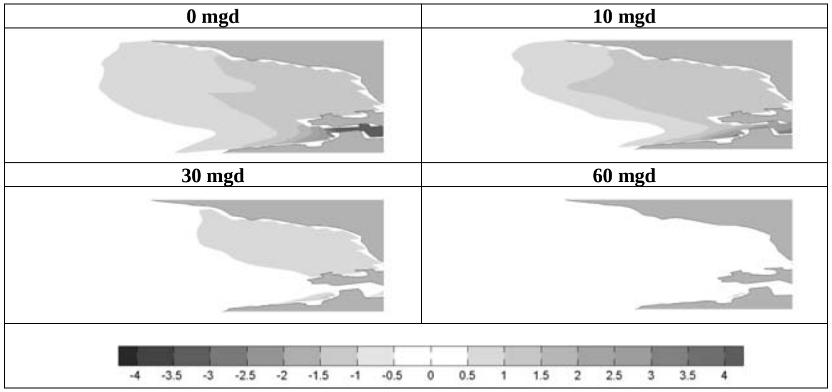

Figure 6-16: Relative increases in Chlorophyll a concentrations at the bottom with exhibit inflow included

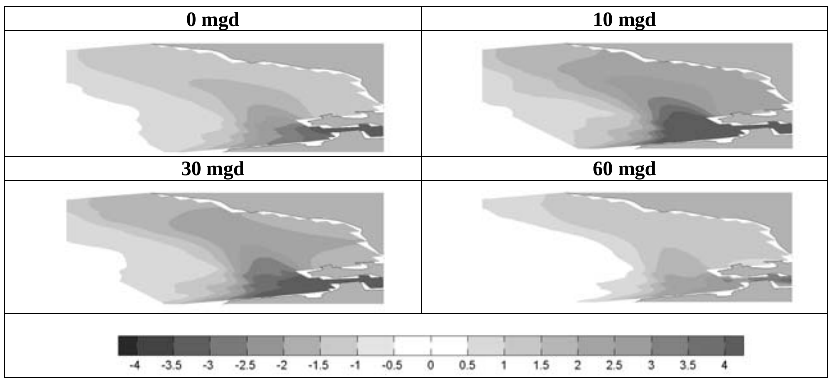

Figure 6-17: Relative increases in Chlorophyll a concentrations at the surface with exhibit inflow excluded

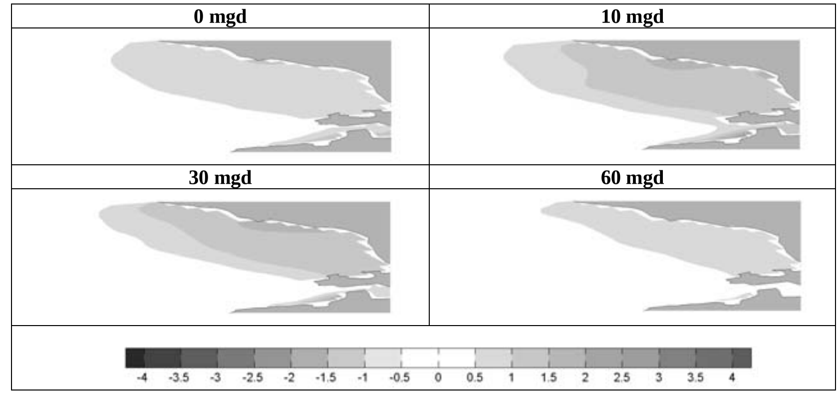

Figure 6-18: Relative increases in Chlorophyll a concentrations at the bottom with exhibit inflow excluded

6.3.4 Conclusions

Due to the increased tidal prism, exhibit inflow, and additional brackish inflow, the flow through the harbor entrance is expected to increase significantly under post-expansion conditions. Depth-averaged velocities through the harbor entrance can be increased by up to 4 times the existing conditions. This increase in velocities is limited to the harbor entrance, and changes outside of this area are not observed. Salinity differences in the surface and bottom are minimal in cases including and excluding exhibit flow.

Relative changes in nutrient concentrations at the surface tend to be higher than the changes at the bottom. When the exhibit flow is included nitrogenous nutrients tend to be higher outside of the Harbor and changes extend into the bottom layers. When the exhibit flow is excluded, the changes in nutrient concentrations tend to remain more confined to the surface layers. With higher brackish inflows, the nutrients also tend to remain more in the surface layers. Higher rates of brackish inflows lead to more nutrient inflow to the system and increases in concentration.

Change in algae growth tends to remain confined to the surface layers. Relative changes can be up to 4 times the existing concentrations. With higher brackish inflow, change in algae growth remains closer to existing conditions in both the surface and the bottom. Waimea Water Services report (2007) states that brackish groundwater entering the new Marina will be significant, so it is expected that post-expansion conditions will resemble the conditions presented for the cases with 30 mgd or higher.

7. SUMMARY AND CONCLUSIONS

The hydrodynamic and water quality existing conditions in Honokohau Harbor were analyzed with existing data sets and a numerical model. This unique system was found to be extremely complex and dependent on the high flushing rate observed under existing conditions. .

The modeled existing water quality conditions within Honokohau Harbor were compared with baseline values reported prior to the construction of the Phase II extension. Overall, Honokohau Harbor has experienced significant improvement from the baseline conditions (1980) to 1991, with corroboration from the 2006 survey (Ziemann, 2006). The concentrations of benchmark parameters NH_4 and o-P have decreased significantly since 1980, with consequent decreases in algal growth (CHLa) and DO deficit. While brackish groundwater inflows remained fairly constant in flow and concentrations, nitrate and silica concentrations increased from 1980 to 2006 in the Harbor. These increases may be attributable to lowered algal populations in the current phosphorous-limited (phosphorous-starved) system, which effectively reduces uptake of NO_3-N and silica, allowing Harbor water column concentrations to increase.

The cause of the DO sag within the Harbor at several sites (mid-Harbor and Front Berthing Basin) may be intermittent wastewater sources, which provide oxygen-demanding carbon and nitrogen loads, as well as plant nutrients. There are insufficient data to quantify the loads or to determine whether they are carbonaceous or nitrogenous. Furthermore, the nutrient data presented by (Bienfang, 1980 and OI, 1991) have very high coefficients of variability (>20%) so that the sampling stations may not be characterized sufficiently for calibration purposes.

The quantity and rate of brackish groundwater entering the existing system has been found to be important. The groundwater's high nutrient loads can be countered only by the high rate of flushing which occurs due to the density currents (low salinity water rising to the surface and flowing out of Honokohau Harbor) created by the groundwater inflow. It was found that maintaining this high rate of flushing is imperative to maintaining the water quality within the proposed system..

A hydrodynamic model was constructed and calibrated using the Delft3D integrated modeling system. This model was calibrated to existing data and applied to examine the hydrodynamic conditions within Honokohau Harbor and the surrounding areas. In addition, the model was extended to include the proposed Kona Kai Ola Marina, post-expansion conditions were examined. The quantity of brackish groundwater entering Kona Kai Ola Marina that was simulated in this study is not necessarily representative of the actual conditions that will occur upon construction of the new Marina. Instead, a range of possible values that could be expected to occur based on the available information were simulated. It is expected that the quantity of brackish groundwater into the new Marina will be significant as it has been reported by Waimea Water Services (2007) who conducted a groundwater survey and study of the project area.

It was found that the construction of the new 800-slip Marina as described in the Conceptual Master Plan causes the flushing time to increase significantly due to its large volume. This is potentially detrimental to the water quality conditions within the Harbor. It was also found that the circulation in the two harbor system is complex and contains significant internal circulation, which limits the existing Harbor's exchange with ocean waters. Under future conditions, the two

layer density driven system is affected, and during the peak ebb flow, there is not any inflowing water due to the large volume of water moving out of the system through the harbor mouth. In addition, the velocities through the harbor mouth are increased in magnitude by up to 4 cm/s during flood tide.

The hydrodynamic model was coupled with a water quality model developed for the observed conditions within Honokohau Harbor. This model was calibrated with data obtained from OI Consultants (1991) and was validated with data from Ziemann (2006). The model's calibration was within an acceptable range for all nutrients and chlorophyll a values. The calibrated model was applied to simulate future conditions including the new Marina included in the Conceptual Master Plan with 800 slips, which consisted of several possible brackish groundwater inflow rates and included the nutrient loads coming from the exhibit areas. The results show that even under the most advantageous flushing scenarios, the water quality within the existing and new Marinas is projected to decrease significantly. Elevated chlorophyll a concentrations persist outside the Harbor. This is primarily due to the decreased flushing of the Harbor post-expansion.

Based on the aforementioned results, it can be concluded that since the 800-slip marina from the Conceptual Master Plan cannot maintain existing water quality conditions it should not be given further consideration. Only if the additional brackish groundwater inflow into the new marina is determined to be greater than 60 mgd, the option of an 800 slip marina could be reevaluated

Alternatives to the Conceptual Master Plan

In order to minimize the effects of the proposed project, different design parameters could be investigated. The EPA's recommended Best Management Practices for increasing flushing of Marinas suggest a number of different options (EPA, 2001: Section 4.1).

- Changing the size or shape of the entrance channel,
- Adding more than one entrance channel,
- Using mechanical aerators in problem areas,
- Optimizing the geometry such that there are as few separated basins as possible, and
- Altering the size of the planned Marina.

In addition, due to the unique conditions experienced in the project area, alternatives associated with the inclusion and positioning of the water exhibit inflow was also considered. Within the conditions of the modeling effort, the alternative considered consists of decreasing the size (volume) of the new Marina to 400 slips (25 acres). Based on numerical model simulations, reducing the Marina volume proved to be an important factor in maintaining water quality conditions in the new marina system independently of the volume of brackish groundwater that will be intercepted by the new Marina. The positioning of the exhibit inflow also seems to affect the water quality within and outside of the marina system.

A formal solution to the proposed system is not attainable without an accurate picture of the brackish groundwater inflow to the system. The interception of large quantities of groundwater tends to increase the flushing through the harbor system which leads to more pristine conditions and less algae growth within the harbor system. This should be considered a likely post-expansion condition based on the study conducted by Waimea Water Services (2007).

Specific water quality results obtained from the 400–slips marina configuration are presented below:

1. Post-Expansion Water Quality Conditions Inside the Marina System

- Existing conditions of nitrate-nitrogen concentrations exceed standards within Honokohau Harbor and concentrations will remain similar in the existing Harbor but could improve in the new Marina due to dilution.
- Ortho-phosphate concentrations are within standards under existing conditions and they will remain similar in both marinas.
- Ammonia-nitrogen concentrations, which are within standards under existing conditions, could increase in the marina where the exhibit flow outfall is placed. This effect could be reduced by reducing the ammonia-nitrogen concentration in the exhibits flow, by reducing the amount of animals in the exhibit (pers. comm. Cloward H2O, 2007 and documented in Appendix D)
- Regarding concentration of Chlorophyll a, conditions for all simulated cases with the 400 slip marina remain within oligotrophic limits. Results showed that the chlorophyll a concentrations could remain within the Class A standards for a 400 slip marina, with the exhibit flow into the new Marina and if the additional brackish groundwater inflow into the new Marina is greater than or equal to 30 mgd, which is the same amount entering Honokohau Harbor under existing conditions.

As previously mentioned, considering the findings from Waimea Water Services (2007) stating that the "proposed marina would exhibit the same or similar flushing action" than the existing marina, and based on the results of the simulations presented in this report, it is expected that the new 400 slip marina will capture more than 30 mgd of brackish water in order to show this flushing behavior. Under these conditions and based on the numerical water quality simulations, water quality conditions in the two marina system, outside of the Marina and at Honokohau Bay will remain very similar to existing conditions. In the case that after construction, the new marina would not show the same flushing behavior as the existing marina Waimea Water Services (2007) suggests a mitigation alternative that it would be possible to enhance the inflow into the new marina by drilling bore holes in the floor of the marina in order to reach the adequate flushing.

2. Post-Expansion conditions outside of the Harbor Mouth

In general, NO_3-N, o-P and NH_4-N concentrations outside of the Harbor mouth after the new Marina construction are expected to be in the same order to those observed under existing conditions. However, Chlorophyll a concentrations appear to be consistently higher than Class AA standards; however they decrease for all cases below the standards for Class A waters. Due to the area's proximity to the Harbor entrance, this may still remain acceptable as long as the algae dies and is diluted within a reasonable distance from the Harbor mouth.

Depth averaged velocities are increased through the Harbor entrance channel by up to 4 cm/s (with a 400 slip marina); however, this increase is confined to a small area immediately surrounding the Harbor entrance.

3. Post-Expansion Water Quality Conditions at Honokohau Bay

Conditions outside of the Harbor were examined briefly, however definitive conclusions based on model results cannot be drawn due to the fact that the model was not calibrated for this region. Results can be used to determine trends of the surrounding areas. The changes in nutrient concentration vary based on the quantity of brackish groundwater. Inclusion of the exhibit waters with the simulated nutrient loads causes a significant difference in ammonia-nitrogen concentrations throughout the Bay, extending into the bottom layers in some cases. The differences in Chlorophyll a concentrations were such that they allow the areas of concern to still remain oligotrophic. In order to develop a fully calibrated model for this region, extensive data collection for calibration and validation would be needed. It was found that the significance of the brackish inflow into Kona Kai Ola Marina also has an effect on the surrounding waters. The concentrations of nutrients in low flow scenarios are relatively less than existing conditions due to the lack of additional nutrients to the system. However, with higher brackish inflow, the growth of algae is more contained.

The results obtained for the 400-slips marina suggest that if the additional brackish groundwater inflow into the new Marina is greater than or in the order of 30 mgd and reducing the ammonia-nitrogen load in the exhibit water, the water quality conditions at both marinas, the harbor entrance and Honokohau Bay will be very similar to the actual conditions.

It is also worth noting, that the following assumptions were considered reasonable and necessary to implement the model:

- The wastewater treatment plant adjacent to the project site would be upgraded to tertiary treatment without discharging directly into the groundwater.
- Measures will be taken to avoid any point or non-point sources entering the marina system, since they could modify the water quality predictions presented in this study.
- Neither waves, ocean currents, nor extreme hydrodynamic conditions were considered.
- Groundwater withdrawals would not affect the brackish inflow to Honokohau Harbor
- The unknown brackish inflow to Kona Kai Ola Marina could be between 0 mgd and 60 mgd.

Due to the uncertainties and assumptions made in the development of the numerical model, it is recommended that a significant monitoring effort be put in place during and following the construction of Kona Kai Ola Marina in order to determine the future ambient conditions and to control any additional inputs not accounted for within the model. Due to the high importance of flushing to maintaining system quality, the post-expansion option suggested by Waimea Water Services (2007) of drilling additional holes in the bottom of the new Marina and the existing Harbor could be used to enhance flushing and improve water quality if needed.

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APPENDIX A – DATA FROM PREVIOUS STUDIES

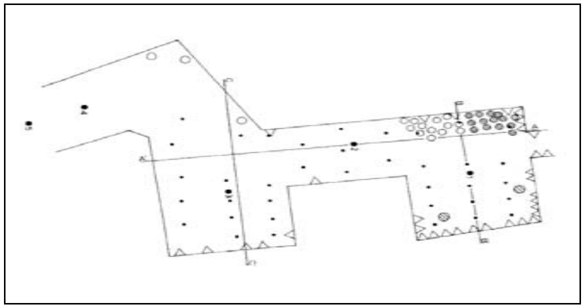

Figure A-1: Bienfang Sampling Locations (1980)

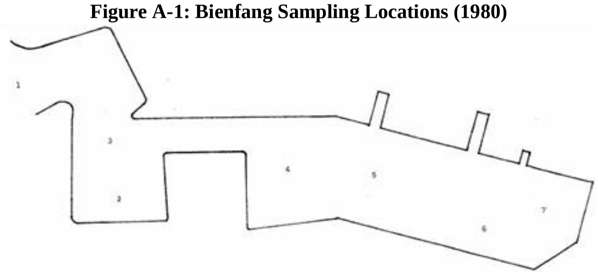

Figure A-2: Bienfang Sample Locations (1982)

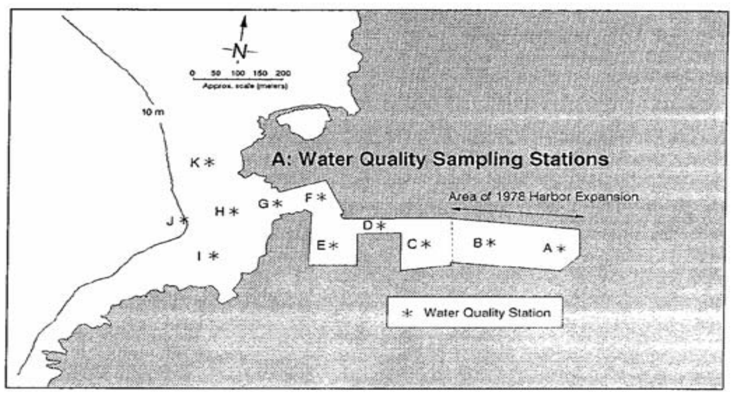

Figure A-3: OI Consultants Sampling Stations (1991)

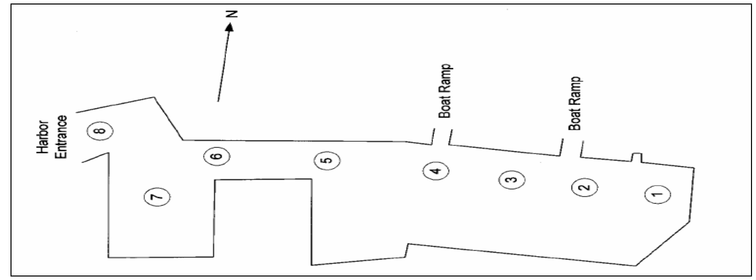

Figure A-4: Ziemann Sampling Stations (2006)

Table A-1: Surface concentrations

Surface

Study	Site	Sample Location Approx.Ziemann	Temp, oC	Sal, ppt	DO, mg/L		DO Deficit, %		NO3, ug-N/L	PO4, ug-P/L	NH4, ug-N/L	Chl, mg/m3	SiO2, ug-Si/L
Bienfang (1980) L	1	4.5	20.5	18.5	4.53		-44		381.8	60.8	18.76	0.10	
Bienfang (1980) L	3	7.0	21.5	30	5.44		-27		329	54.56	16.9	0.1	
Bienfang (1980) H	1	4.5	20.5	18.5	4.53		-44		471.2	77.5	7.70	0.06	
Bienfang (1980) H	3	7.0	21.5	30	5.44		-27		322	48.98	7.6	0.1	
Bienfang (1982) L	7	1							425.6	62.62	3.78	1.68	
Bienfang (1982) L	6	2							525	53.94	0.14	3.47	
Bienfang (1982) L	5	4							460.6	41.85	2.66	0.36	
Bienfang (1982) L	4	5							592.83	66.96	0.14	5.02	
Bienfang (1982) L	3	7							296.52	70.06	1.54	2.76	
Bienfang (1982) L	2	8							441.42	57.04	2.66	0.56	
OI (1991) L	A	1	21.42	24.06	5.34		-30		277.8	54.0	14.14	0.07	2891.4
OI (1991) L	B	3	21.65	27.09	5.49		-27		277.7	46.1	5.19	0.62	3157.4
OI (1991) L	C	4.5	21.57	26.00	5.59		-26		179.8	39.7	4.77	0.11	2582.2
OI (1991) L	D	6	21.82	27.02	5.83		-22		121.1	36.1	14.71	0.12	2188.1
OI (1991) L	E	7	22.91	27.74	5.93		-19		313.2	42.4	3.75	0.16	3168.3
OI (1991) L	F	8	22.48	27.75	6.15		-17		226.1	37.9	5.79	0.10	3003.7
OI (1991) L	G		24.21	30.97	5.87		-16		251.7	33.3	6.10	0.17	2879.5
OI (1991) H	A	1	20.88	24.27	5.34		-31		325.2	54.5	7.75	0.07	5149.5
OI (1991) H	B	3	21.78	27.64	5.50		-26		246.8	194.7	6.87	0.65	3447.5
OI (1991) H	C	4.5	21.79	26.77	7.98		6		240.6	169.5	5.79	0.07	2671.9
OI (1991) H	D	6	22.58	27.55	6.45		-13		231.9	167.3	4.95	0.10	3985.3
OI (1991) H	E	7	23.04	27.57	7.46		2		202.2	106.6	3.37	0.12	2206.1
OI (1991) H	F	8	23.87	29.21	6.74		-6		164.7	100.5	4.67	0.12	2764.2
OI (1991) H	G		24.05	31.78	7.15		2		73.5	50.4	4.07	0.32	1351.1
Ziemann (2006)	1	1	24.40	22.60	6.22		-15		660.0	22.0	1.00	0.12	10810.0
Ziemann (2006)	2	2	24.2	21.5	6.35		-14		590.0	28.0	1.00	0.09	10320.0
Ziemann (2006)	3	3	24.4	25.3	6.89		-5		389.0	14.0	1.00	0.22	11220.0
Ziemann (2006)	4	4	25.1	24.9	6.31		-12		218.0	16.0	1.00	0.43	8830.0
Ziemann (2006)	5	5	21.3	25	6.22		-19		520.0	16.0	1.00	0.11	8800.0
Ziemann (2006)	6	6	21.4	26.9	6.24		-17		596.0	22.0	1.10	0.16	7799.0
Ziemann (2006)	7	7	23	26.4	6.8		-8		640.0	27.0	1.90	0.18	9768.0
Ziemann (2006)	8	8	22.9	28.9	6.73		-7		430.0	18.0	1.30	0.20	6738.0

Table A-2: Bottom Concentrations

Bottom

Study	Site	Sample Location Approx.Ziemann	Temp, oC	Sal, ppt	DO, mg/L		DO Deficit, %		NO3, ug-N/L	PO4, ug-P/L	NH4, ug-N/L	Chl, mg/m3	SiO2, ug-Si/L
Bienfang (1980) L	1	4.5	24.5	35	5.83	6.83	-15		53.2	9.9	8.12	0.55	
Bienfang (1980) L	3	7.0	24.5	35	5.18	6.83	-24		6.7	6.5	12.88	0.24	
Bienfang (1980) H	1	4.5	24.5	35	5.83	6.83	-15		53.9	12.1	3.92	0.70	
Bienfang (1980) H	3	7.0	24.5	35	5.18	6.83	-24		17.9	9.9	8.54	0.43	
Bienfang (1982) L	7	1							8.54	11.78	3.78	55.42	
Bienfang (1982) L	6	2							14.7	6.51	4.06	35.27	
Bienfang (1982) L	5	4							11.62	17.05	3.36	15.47	
Bienfang (1982) L	4	5							4.9	3.41	3.78	6.63	
Bienfang (1982) L	3	7							0	16.43	4.06	1.38	
Bienfang (1982) L	2	8							0	4.03	6.16	0.37	
OI (1991) L	A	1	22.25	29.01	5.87	7.35	-20		170.8	36.9	10.03	1.88	2671.0
OI (1991) L	B	3	24.36	32.18	5.81	6.96	-16		140.8	26.7	6.79	3.21	2422.8
OI (1991) L	C	4.5	24.10	31.45	6.41	7.02	-9		129.3	34.1	11.25	6.40	2479.0
OI (1991) L	D	6	24.77	32.31	6.58	6.90	-5		52.6	16.0	5.75	4.44	1493.2
OI (1991) L	E	7	24.82	34.32	6.60	6.82	-3		11.9	9.3	5.33	5.47	471.1
OI (1991) L	F	7	24.75	34.09	6.49	6.84	-5		18.9	9.6	3.47	0.52	742.5
OI (1991) L	G	8	24.65	34.60	6.54	6.83	-4		40.0	7.0	7.64	0.31	734.6
OI (1991) H	A	1	23.62	30.46	8.04	7.12	13		94.5	79.3	8.21	1.44	3519.7
OI (1991) H	B	3											
OI (1991) H	C	4.5											
OI (1991) H	D	6											
OI (1991) H	E	7											
OI (1991) H	F	7											
OI (1991) H	G	8											
Ziemann (2006)	1	1	24.60	29.90	6.52	7.02	-7	8	196.0	16.0	1.00	0.56	6610.0
Ziemann (2006)	2	2	21.3	30.1	6.48	7.434	-13	8	210.0	12.0	1.00	0.25	5010.0
Ziemann (2006)	3	3	24.3	30.7	6.57	7.024	-6	8	404.0	10.0	1.00	0.55	5040.0
Ziemann (2006)	4	4	25.7	30.8	6.59	6.853	-4	8	206.0	12.0	1.10	0.54	5320.0
Ziemann (2006)	5	5	24.3	31.2	6.72	7.004	-4	8	190.0	12.0	2.80	1.16	3704.0
Ziemann (2006)	6	6	23.9	31.6	6.88	7.037	-2	8	240.0	20.0	2.90	0.90	6195.0
Ziemann (2006)	7	7	24.30	32.30	6.83	6.96	-2	8	160.0	10.0	2.20	0.58	2875.0
Ziemann (2006)	8	8	24.2	32.4	7.12	6.968	2	8	120.0	8.0	1.90	0.41	2397.0

APPENDIX B – DESCRIPTION OF FLUSHING TIME CALIBRATION

FLUSHING TIME CALIBRATION

The hydrodynamic model was used to calibrate the dispersion coefficient and the groundwater discharge rate. The data obtained during the dye study that was conducted in March 1991 was used to tune the model.

Residence Time

The concentration of a constituent within an enclosed body of water like a harbor which is dominated by tidal effects can be described by

$$C = C_0 e^{-t/T}$$

Where C_0 is the initial concentration and C is the concentration of the constituent at time t. T is considered to be the flushing time constant or the residence time of the particle. This approach is often referred to as the "e-folding" approach (Monsen *et al*, 2002). The residence time, T, can be considered to be the time required for reduction of a conservative tracer concentration to $1/e$ or 36.8% of its initial value, or a reduction of 63.2%. Mathematically, assuming an exponential distribution of times for individual water particles to reach the ocean, when the concentration of particles reaches 1/e, it represents the average time of all particles to reach the ocean.

If the natural logarithm of the above equation is written as

$$\ln(C) = \ln(C_0) - t/T$$

then it is seen that the natural logarithm of the concentration of a tracer is a linear function of the time with a slope of $-1/T$. In this way, the residence time can be estimated without knowing the initial concentration. This method of computing the residence time was used in the studies conducted by OI Consultants (1991).

Sensitivity Analysis

In this case, to follow the analysis presented in the study conducted by OI Consultants, Inc., the computation of a flushing time constant, T, was used to represent the residence time in the harbor. In order to do this, various combinations of groundwater discharge and dispersion coefficients were chosen to test the model sensitivity. The hydrodynamics for each of these combinations were coupled to a water quality module that was seeded with a conservative tracer up to the mouth of the harbor (Figure 1). This model containing the conservative tracer was then started at the point of last release of the Rhodameine dye at 13:00 March 14, 1991.

Varying the flow rate was found to be important in transporting the substance primarily in the surface layer. For example, when the flow rate was kept at a low value such as 8 mgd which is more consistent with the rates produced by Bienfang (1980) and cited in (OI Consultants, 1991), the model could not transport the substances even out of the surface layer. However using a higher flow rate of 30 mgd, which is more consistent with the rate produced by Gallagher (1980), produces a more reasonable distribution of salinity as well as a flushing time constant consistent with those reported by Gallagher (1980) and OI Consultants (1991) based on measurements within the Harbor.

The field study conducted by OI Consultants (1991) shows flushing time constants within the Harbor to be fairly depth uniform. Dispersion coefficients were varied between 0.1 m^2/s and 1 m^2/s. Independently of the flow rate it was found that using dispersion coefficients at the upper limit promoted too much mixing impacting the salinity gradients throughout the harbor. Using dispersion coefficients at the lower limit caused little to no mixing of the conservative tracer in the lower layers over the three day period. This is not consistent with what was observed in field measurements. Therefore, the dispersion coefficient was calibrated with the flow rate to provide the best results with respect to flushing time throughout the harbor and the salinity gradients that result.

Thirteen cases were tested within the parameters described above. They are presented in Table B-1.

Table B-2: Description of sensitivity cases

Case	Groundwater inflow	Dispersion
1	8	0.1
2	8	0.5
3	15	0.5
4	20	0.1
5	20	1
6	25	0.3
7	25	0.5
8	30	0.3
9	30	0.5
10	30	0.6
11	30	0.7
12	30	0.8
13	35	0.8

In order to compute the residence time for each of these cases, the hydrodynamics under these conditions were used to drive the Delft3D WAQ module. In order to replicate conditions that under the study conducted by OI Consultants (1991), the model was seeded with a conservative tracer with an initial concentration of 1 g/m^3 throughout each depth layer. Outside of the harbor the concentration was set with an initial value of 0 g/m^3. The initial conditions within the harbor are shown in Figure. This model was run at an initial time equal to the time at which the dye injection was completed, 13:00 March 14, 1991. The model was run for a four day period.

Figure B-1: Initial conditions of conservative tracer concentration (red=1, blue=0)

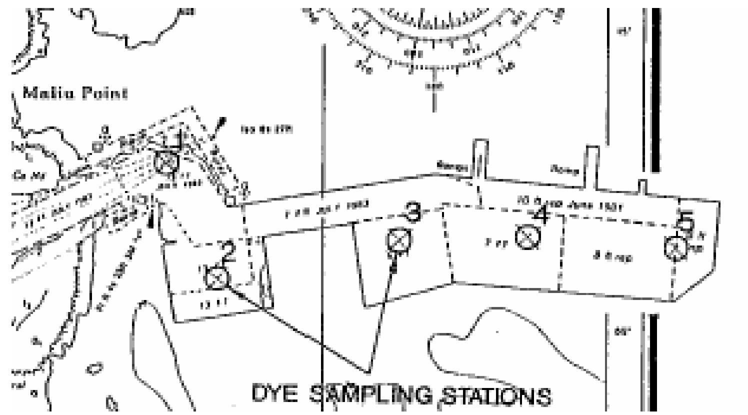

Figure B-2: Dye Sampling stations from OI Consultants (1991)

Using concentration results extracted from the model at each of the five stations shown in Figure B-2, a similar analysis was performed in order to find *T* for depths at the top, middle and bottom of the water column. The results for all tests are shown in Table B-2.

Table B-1: Flushing times

		Station 1	Station 2	Station 3	Station 4	Station 5
Case 1	Top	1.83	1.80	1.77	1.58	1.56
	Middle	2.17	1.60	1.35	0.78	0.84
	Bottom	2.28	2.50	2.27	0.87	0.83
Case 2	Top	0.88	0.89	0.91	0.92	0.93
	Middle	0.87	0.88	0.90	0.78	0.79
	Bottom	0.84	0.77	0.74	0.63	0.68
Case 3	Top	1.28	1.29	1.30	1.23	1.25
	Middle	1.31	1.23	1.29	0.85	0.79
	Bottom	1.17	0.83	0.72	0.51	0.47
Case 4	Top	1.98	1.83	1.71	1.32	1.30
	Middle	3.01	1.62	1.41	0.67	0.67
	Bottom	3.02	2.42	1.49	0.68	0.64
Case 5	Top	0.49	0.49	0.49	0.50	0.50
	Middle	0.49	0.49	0.50	0.48	0.48
	Bottom	0.47	0.47	0.47	0.44	0.46
Case 6	Top	1.06	1.05	1.05	1.02	1.02
	Middle	1.10	1.05	1.04	0.88	0.84
	Bottom	1.06	0.91	0.87	0.79	0.80
Case 7	Top	0.92	0.90	0.89	0.86	0.86
	Middle	0.96	0.92	0.94	0.71	0.71
	Bottom	0.84	0.66	0.61	0.45	0.51
Case 8	Top	1.02	1.02	1.01	0.99	0.98
	Middle	1.05	1.03	1.02	0.90	0.87
	Bottom	1.02	0.91	0.89	0.81	0.83
Case 9	Top	0.86	0.84	0.82	0.79	0.79
	Middle	0.90	0.89	0.89	0.71	0.71
	Bottom	0.79	0.64	0.60	0.46	0.52
Case 10	Top	0.60	0.60	0.60	0.61	0.61
	Middle	0.61	0.61	0.61	0.60	0.60
	Bottom	0.60	0.59	0.58	0.55	0.59
Case 11	Top	0.53	0.53	0.53	0.53	0.54
	Middle	0.53	0.54	0.54	0.53	0.53
	Bottom	0.52	0.52	0.52	0.49	0.52
Case12	Top	0.49	0.49	0.49	0.50	0.50
	Middle	0.49	0.49	0.50	0.48	0.48
	Bottom	0.47	0.46	0.46	0.41	0.44
Case13	Top	0.47	0.47	0.47	0.47	0.47
	Middle	0.47	0.47	0.48	0.46	0.47
	Bottom	0.46	0.45	0.45	0.41	0.44

Note that for tests with small dispersion coefficients (<0.5) the depth variability in the flushing time is high, which can be seen from the standard deviations at each of the stations. Case 4 had the highest variation in depth since it had both a high groundwater flowrate (20 mgd) and a low dispersion (0.1 m^2/s), so that the brackish inflow mainly stayed in the surface layer while not mixing with the saltwater in the lower layer. Both Cases (1 and 4) with dispersion coefficients of 0.1 m^2/s had high depth variation with standard deviations greater than 0.5. The test with the mean flushing time closest to that reported in OI Consultants (1991) and that reported by Gallagher (1980) was the case with 20 mgd groundwater infiltration rate and 1 m^2/s dispersion coefficient. However, this case did not meet salinity show the salinity layers well enough due to too much mixing with the high dispersion coefficient. Therefore, the best case was the case with 30 mgd of groundwater infiltration and a dispersion coefficient of 0.7 m^2/s. This yields a low variation with depth (STD about 0.1) and a mean flushing time of 0.53, which is about 12 hours as reported by Gallagher (1980).

	Station 1	Station2	Station3	Station 4	Station 5	Average Harbor
			Case 1			
Mean	2.09	1.97	1.80	1.08	1.08	1.60
STD	0.23	0.47	0.46	0.44	0.42	0.57
			Case 2			
Mean	0.86	0.85	0.85	0.78	0.80	0.83
STD	0.02	0.07	0.10	0.15	0.13	0.09
			Case 3			
Mean	1.25	1.12	1.10	0.86	0.84	1.03
STD	0.07	0.25	0.33	0.36	0.39	0.31
			Case 4			
Mean	2.67	1.96	1.54	0.89	0.87	1.58
STD	0.60	0.41	0.16	0.37	0.37	0.78
			Case 5			
Mean	0.48	0.48	0.49	0.47	0.48	0.48
STD	0.01	0.01	0.02	0.03	0.02	0.02
			Case 6			
Mean	1.07	1.00	0.99	0.90	0.89	0.97
STD	0.02	0.08	0.10	0.12	0.12	0.11
			Case 7			
Mean	0.91	0.83	0.81	0.67	0.69	0.78
STD	0.06	0.14	0.18	0.21	0.18	0.16
			Case 8			
Mean	1.03	0.99	0.97	0.90	0.89	0.96
STD	0.02	0.07	0.07	0.09	0.08	0.08
			Case 9			
Mean	0.85	0.79	0.77	0.65	0.67	0.75
STD	0.06	0.13	0.15	0.17	0.14	0.14
			Case 10			
Mean	0.60	0.60	0.60	0.59	0.60	0.60
STD	0.01	0.01	0.02	0.03	0.01	0.02
			Case 11			
Mean	0.53	0.53	0.53	0.52	0.53	0.53
STD	0.01	0.01	0.01	0.02	0.01	0.01
			Case 12			
Mean	0.48	0.48	0.48	0.46	0.47	0.48
STD	0.01	0.02	0.02	0.05	0.03	0.03
			Case 13			
Mean	0.47	0.46	0.47	0.45	0.46	0.46
STD	0.01	0.01	0.02	0.03	0.02	0.02

APPENDIX C – ANALYSIS OF WASTEWATER TREATMENT PLANT NUTRIENT LOADS

Date: February 13, 2007

To: Kona Kai Ola Project Team, File

From: Lauren Schmied, Rafael Cañizares

CC: John Headland, Russ Boudreau

Subject: Kona Kai Ola Water Quality Model
Clarification of Assumptions Regarding WWTP
M&N File 5818

A brief analysis was performed to determine the effects on the water quality of the brackish groundwater entering the system after the Marina expansion and the upgrade to the local wastewater treatment plant (WWTP). It is estimated that if the WWTP were to be left in its current state (secondary treatment), the water quality into the new Marina would contain significantly higher nutrient loads than those entering the current Harbor. This is based on the information presented in Waimea Water Services, Inc. (2006). The data presented by AECOS as an appendix in the aforementioned document shows that the nutrient values at Wells 2 and 6 are significantly higher than other wells within the Park (Table C-1). Well 2 has the highest concentrations as this is closest to the point where the wastewater is discharged (DEIS, 2006). Well 6 is shown to be proximal to the location of the new Marina, and thus the values of nutrients entering the new Marina without upgrading the WWTP would be similar to those found at Well 6. This introduces a much higher phosphorous load into the system. In the Hydrodynamic and Water Quality Modeling draft report prepared by Moffatt and Nichol (February 2007), the phosphorous concentration within the new Marina is shown to be one of the significant water quality problems facing the expansion.

Table C-1: Water Quality Conditions as reported by AECOS (2006)

	Well 2	**Well 6**	**Harbor Spring**	**Quarry Well**
Salinity (ppt)	4.4	18.4	25.1	5.3
Nitrate (mg-N/L)	0.54	0.59	0.42	1.20
TP (mg-P/L)	2.71	0.62	3.70	0.07
Ammonia (mg-N/L)	0.005	0.002	0.003	0.003

The DEIS (submitted December 2006) states that the existing WWTP will be upgraded to tertiary treatment and will no longer be discharged into the groundwater. In order to determine the water quality of the brackish water entering the existing Harbor and the new Marina without the effects of the WWTP effluent, the values of the Quarry Well sampling (Table C-1) were assumed to be representative of water without the effects of the WWTP as it is located upstream of the injection site. Values from Quarry Well were diluted with oceanic water (including the nutrient loads of the background ocean conditions) to the salinity of the water entering the existing Harbor (on the order of 22 ppt), resulting in values not significantly different to those already used as input to the water quality model. Table C-2shows the values reported by various

researchers of the brackish water entering the Harbor. It is seen that these values remained fairly constant over the years. Comparing these values to those computed from diluting the Quarry Well data shows that the WWTP effluent effect on the waters entering the existing Harbor is fairly negligible, and therefore the values used in the model represent brackish water with no wastewater effects. This represents the conditions that will occur upon completion of the WWTP upgrade.

If current wastewater effects were to be considered in the model, their effect to the new Marina would be significant as the phosphorous values measured at Well 6 (Table C-1), are much higher than those used within the model. It appears that the new Marina intersects the pathways of the brackish groundwater carrying the WWTP effluent from its actual discharge location, and so without an upgrade to the current system, the simulated water quality conditions would be much worse than the results presented in the Hydrodynamic and Water Quality Modeling draft report prepared by Moffatt and Nichol (February 2007).

Table C-2: Estimate of Water Quality Conditions at the New Marina location without WWTP discharge

	AECOS (2006 Harbor Spring)	**Hoover and Gold (2005) (22 ppt)**	**Johnson *et al.* (2006) (22 ppt)**	**Bienfang (1980)**	**Model Inputs**	**Computed Dilution Values (2006 Quarry Well)**
NO_3-N	0.42 mg-N/L	0.336 mg-N/L	0.434 mg-N/L	0.5 mg-N/L	0.42 mg-N/L	0.513 mg-N/L
PO_4-P	-	0.0465 mg-P/L	0.0589 mg-P/L	0.0744 mg-P/L	0.06 mg-N/L	0.052 mg-P/L
NH_4-N	0.003 mg-N/L	0.014 mg-N/L	-	-	0.014 mg-N/L	0.002 mg-N/L

REFERENCES

Bienfang, P. (1980). “Water Quality Characteristics of Honokohau Harbor: A Subtropical Embayment Affected by Groundwater Intrusion.” Pacific Science, vol 34(3). pp. 279-291.

Hoover, Daniel and Gold, Collette, National Park Service, U.S. Department of the Interior (2005). “Assessment of Coastal Water Resources and Watershed Conditions in Kaloko-Honokohau National Historic Park, Hawaii.” Technical Report NPS/NRWRD/NRTR-2005/344.

Johnson, A., C. Glenn, P. Lucey, W. Burnett, R. Peterson, H. Dulaiova, and E. Grossman (2006). “Thermal Infrared surveys and nutrients reveal substantial submarine groundwater discharge systems emanating from the Kona coast of Hawaii.” *Eos Trans. AGU, 87*(36), Ocean Sci. Meet. Suppl., Abstract OS15B-06.

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APPENDIX D – NUTRIENT LOADS FROM MARINE EXHIBITS (CLOWARDH2O)

DESCRIPTION OF CALCULATIONS FROM CLOWARD H2O

Nitrogen – Almost all of the nitrogen introduced into the aquarium is excreted by the fish in the form of ionized and un-ionized ammonia. Due to the rapid flushing of the exhibit tanks, (less than 3 hours for all exhibits) there is insufficient time of any significant metabolism of the ammonia to nitrite/nitrate. Each kg of feed typically produces .03kg of total N. (Timmons and Losordo, 1994)

TSS – Each kg of feed will produce 0.30kg of solids waste (Timmons and Losordo, 1994)

Phosphorous – Fish requirements for phosphorous in their diet is small, though important to proper development, particularly of the skeletal and scale structures. Most metabolic P wastes are excreted as phosphate via the urine. The levels of those P excretions are determined by plasma phosphate concentration within the animals (D. Bureau. 2004). By controlling the dietary intake of phosphorous in the animals, the excretions of phosphorous are minimized and controlled to insignificant levels.

Table D-1: Calculation of nutrients for water features

Feature	Surface Area, Acres	Surface Area, Sq.Ft.	Average Depth, Ft.	Volume, Gallons	Turnover, Minutes	Flow Rate, Gpm	Weighted Average Turnover Time, Minutes	Weighted Average Flow Rate, New Water, GPM	Lbs of Fish, based on 1 lb/100 gallons of water	Kg of Feed at 2% of body weight per day	Kgs of Suspended solids produced per day	Kgs of Ammonia produced per day as mg/l of total nitrogen TAN
Upper Lagoon	4.5	196,020	4	5,864,918	360	16,291	147.4403		0	0	0	0
Dolphin Lagoon	0.75	32,670	6	1,466,230	160	9,164	16.38225		14,662	133.2936	39.98808	3.998808
Dolphin Holding	0.2	8,712	10	651,658	160	4,073	7.281001	4887	6,517	59.2416	17.77248	1.777248
Snorkel Lagoon	0.75	32,670	7	1,710,601	70	24,437	8.361775	48874	17,106	155.5092	46.65276	4.665276
Ray Lagoon/kids touch and v	0.4	17,424	3	390,995	120	3,258	3.276451	8146	3,910	35.54496	10.663488	1.066349
Shark Lagoon	0.3	13,068	8	781,989	120	6,517	6.552901	10861	7,820	71.08992	21.326976	2.132698
Turtles and Biters	0.2	8,712	8	521,326	120	4,344	4.368601	6517	5,213	47.39328	14.217984	1.421798
Swim Lagoon	3	130,680	3	2,932,459	360	8,146	73.72014		0	0	0	0
Total	10.1	439,956	49	14,320,176	1,470	51,793	267	53,557	55,228	502.0726	150.62177	15.06218

REFERENCES

Timmons, M. B. and Losordo, T. M. (2006). Aquaculture Water Resuse Systems: Engineering Design and Management. Elsevier Science B. V.

Bureau, D. P. (2004). “Factors Affecting Metabolic Waste Outputs in Fish,” Fish Nutrition Research laboratory, University of Guelph, Guelph, Ontario, Canada.

Attachment 3

- Twenty-nine sites are ~~recommended~~ proposed for preservation in accordance with a Site Preservation Plan prepared for DLNR-SHPD review and approval. Of the 29, 25 are located on lands owned by DLNR and four are on DHHL lands. These preservation sites include thirteen sites within the legislative boundary of Kaloko-Honokōhau National Historical Park that the developer intends to preserve.
- The specific plans for preservation and maintenance of the burial features at five sites would be detailed in a Burial Treatment Plan prepared for DLNR-SHPD and the Hawai‘i Island Burial Council (HIBC) review and approval.

The levels of impact and mitigation measures related to the proposed project are similar in Alternatives 1 and 2.

4.3 Visual Resources

4.3.1 Existing Conditions

The *Hawai‘i County General Plan* characterizes the scenic beauty of various areas and identifies sites and vistas of natural beauty. Although the subject property is not specifically listed as an example of natural beauty within the Kona districts, the view plane extending mauka and makai from Queen Ka‘ahumanu Highway is identified as such a site. The large geographical area within this view plane includes the project site.

- *Palm Tree Corridor:* There is a palm tree-lined road corridor extending makai from Queen Ka‘ahumanu Highway leading to Honokōhau Harbor. The corridor is flanked by mature palm trees, some fronted by memorial plaques. While this lane is not formally acknowledged by the County, nor protected under County or State statutes, it is acknowledged here as it is a unique feature of interest.
- *Proposed Harbormaster Facility:* The Kona Kai Ola project will utilize the existing Honokōhau Harbor entrance channel. DOBOR officials have expressed the importance of a harbormaster location with a clear view of the ocean entrance for boater safety reasons. At present the appropriate location is considered to be north of and across from the interior channel from the existing fuel dock. This would provide a much better view than the fuel dock side of the channel due to the visual obstruction associated with the existing park on the south side of the ocean entrance. This location was selected as the optimum position for controlling boat movement from both basins and through the existing ocean channel from a health and safety standard.
- *Mauka views:* Mauka views from the shore area, the proposed cultural park area and from the ocean are important from both a cultural and community quality of life perspective. As more of the West Hawai‘i coast become developed, the expansive views formerly so common, are jeopardized. Mount Hualālai, framed in the background by Mauna Loa and Mauna Kea, is a prominent feature of North and South Kona and is a landmark along Queen Ka‘ahumanu Highway.

4.3.2 Anticipated Impacts and ~~Recommended~~ Proposed Mitigation

Due to its location within the Queen Ka'ahumanu Highway view plane, the project has the potential to impact public views of the coastline in this area of North Kona. In addition to the General Plan, the *West Hawai'i Coastal View Study* of 1990 notes that "urbanization and public improvements may …offer the greatest opportunity to protect, preserve, and where desirable, restore or improve the quality of coastal scenic and open space resources."

Depending on the development plan for the commercial parcel, the palm trees along the existing entrance road to the harbor may need to be removed. However, portions of a proposed roadway may be able to incorporate some of the existing palm trees.

The proposed Harbormaster Control Tower is proposed to be a small two-story structure set back approximately 500 feet from the harbor entry channel and located in a small second floor area. Hence, this facility will be visible from the ocean and the Kaloko-Honokōhau National Historical Park. Marina designers and DOBOR have determined that the harbormaster facility needs to be at the proposed location and at the proposed height to ensure the safety of marina traffic into and around the existing Honokōhau Harbor and the new marina. To mitigate view impacts on the adjacent Kaloko-Honokōhau National Historical Park, design measures to minimize impacts will be employed. Further, it is proposed that the ground floor of the ~~Harbormaster Control Tower~~harbormaster observation hale be made available for park uses, such as a visitor center. Alternatively, the harbor master observation hale may only be a single story building.

To mitigate visual impacts, a 400-foot buffer zone along the shoreline will be preserved as open space. Improvements within this buffer zone will be limited to lateral shoreline public trails, mauka-makai access trails from the project site, and cultural or environmental-related improvements relating to existing features within the buffer zone. No buildings or structures shall be proposed within the 400-foot shoreline setback area, with the possible exception of culturally-related structures.

To control building mass near the shoreline, development sites directly adjacent to the shoreline area are limited by design covenants to a lower unit density. Buildings immediately adjacent to the shoreline setback are proposed at one and two stories height to minimize building mass against the shoreline setback area.

Buildings located further inland will increase to a maximum of four stories, in keeping with the "coconut tree height" general limit. The quantity of landscaped or re-naturalized open space should be emphasized near the setback area by design covenants.

The northern edge of the large commercial parcel contiguous to the water feature by Queen Ka'ahumanu Highway will be limited by design covenants to one-story structures. Structures on the remaining area of the parcel will be limited to the equivalent of three stories in height. The larger building mass at the southern portion of the parcel will provide a screen for the existing earth berm around the waste-water treatment plant from the Highway.

Major roadways, parking areas, and areas surrounding all major structures will be landscaped in accordance with a landscape master plan.

A visual impact study was conducted to illustrate various views of the Kona Kai Ola development. In the computer simulated views, no existing buildings are shown on the existing harbor area.

Five views are illustrated and in this FEIS and are described as follows:

- Figure U-1: View from the Villages of La‘i ‘Ōpua.

  This gives an overall mauka to makai view of the entire project from the Villages of La‘i ‘Ōpua. The existing wastewater treatment plant and the lands belonging to Queen Lili‘uokalani Trust are to the left. The National Historical Park and existing entry channel to Honokōhau small boat harbor are to the right. Queen Ka’ahumanu Highway is in the foreground with the ocean in the background.

  The existing view of the site from this vantage point is of a barren lava field devoid of vegetation that gently slopes to the ocean. The large pools of the existing wastewater treatment plant dominate this desolate landscape. This computerized view of the proposed project depicts how Kona Kai Ola intends to transform this desolate lava field into a vibrant mixed use community. This view also shows how the project will retain 40% of the land area in open space with lagoons, community areas and a vast shoreline park.

  The project’s proposed roadway system can be clearly seen. The Kuakini Highway Extension Right of Way is depicted in the foreground. A new access road that will serve the existing marina is on the lower right. On the left is a collector road that borders the wastewater treatment plant and provides access to the uses along the coastline. A road also connects these two roads through the core of the project. Finally, there is a road that will service the uses along the coastline and provide access to the park at the harbor’s entrance.

  The water feature through the central core of the project is clearly visible. This central feature provides an amenity to the mauka parcels as it meanders through the project to the proposed marina to help with water circulation.

  The buildings within the project are no more than three to four stories tall or no higher than a coconut tree.

- Figure U-2: View of the main entrance into the project.

  The existing wastewater treatment plant and the lands belonging to Queen Lili‘uokalani Trust are to the left. The National Historical Park and existing entry channel to Honokōhau small boat harbor are to the right. Queen Ka‘ahumanu Highway and main entrance to the project are in the foreground.

  The existing view from this vantage point is of the existing intersection of Queen Ka‘ahumanu Highway and the access road to Honokōhau Harbor. Barren lava fields extend out from the road to the north and south. The road is lined with coconut trees. The access road leads to the existing HonokōhauHarbor to the east.

This view shows the proposed main entrance into the project at the intersection of the Queen Kaʻahumanu Highway and the proposed Kuakini Highway Extension. The Kuakini Highway Extension veers to the left upon entering the project and extends all the way to Kailua-Kona. This proposed roadway will provide a parallel route to Queen Kaʻahumanu Highway, alleviate traffic in the region, and provide an important alternate route into Kailua-Kona.

This view also shows the inviting main entry to the project, which is accomplished by the retention of a large open space area and using setbacks along the Kuakini Highway Extension. The coconut trees along the existing access road to the harbor, will be carefully relocated to a site within the project and provided with necessary care and irrigation. The open area along the highway is a planned natural park with a brackish water pond, designed as a habitat for migratory birds that currently visit the area. A view corridor connecting this park through the core of the project to the proposed marina was designed to create mauka and makai views through the interior of the project.

- Figure U-3: View from North Side of Honokōhau Harbor Entrance Channel

This gives a view looking from the north side of the entrance channel near the makai entry to the Kaloko Honokōhau National Historical Park. The image only shows the new construction that will be added to the existing fuel dock and various State buildings that already located in this area near the fuel dock lease area. The small harbormaster observation hale is shown in the foreground. This is shown as a small two story structure, but it could alternatively be only a single story.

To the right on the makai side, the shoreline cultural park can be seen, along with a proposed cultural center located adjacent to the cultural park. Also shown is a conceptual design for an outdoor hula performance area. The trail is shown for illustrative purposes only and would be designed to blend in with the natural lava landscape. The anchialine pools and historic sites are not shown, but will be protected in the shoreline cultural park. The buildings close to the shoreline park are limited to one and two story buildings, while the buildings closer to the marina are shown at a height of four stories at the highest. The new harbor basin, shown at 800 slips, is surrounded by a public promenade, with a mix of commercial, hotel, time-share uses, as well as public parks for launching one and two-man outrigger canoes. The vessels currently in the outer basin of the existing harbor would be moved into the new harbor facility, leaving the whole area of the outer basin for transiting to and from the new harbor to the ocean.

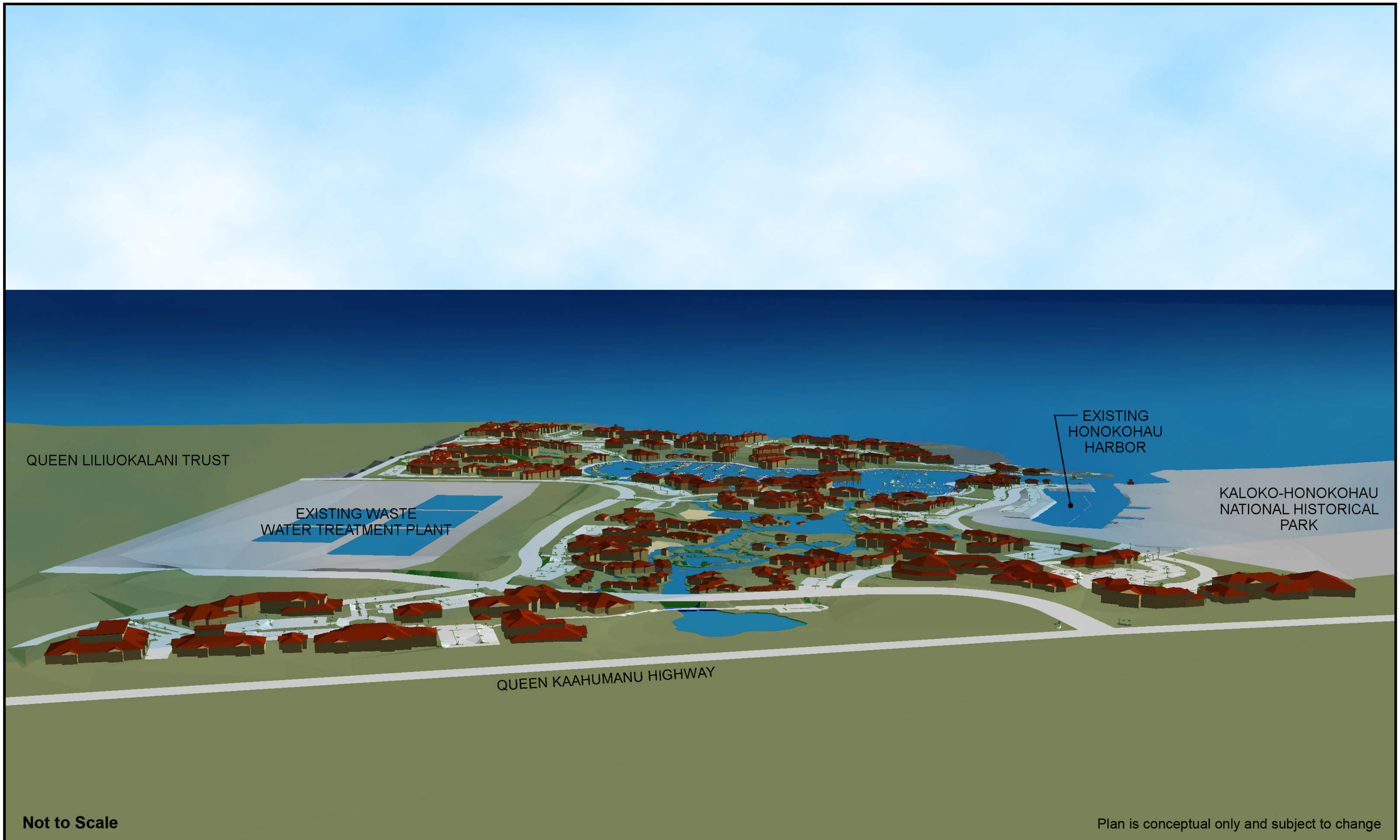

Figure U-1: View from Villages of La‘i ‘Ōpua

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Figure U-2: View of Main Entrance Into the Project

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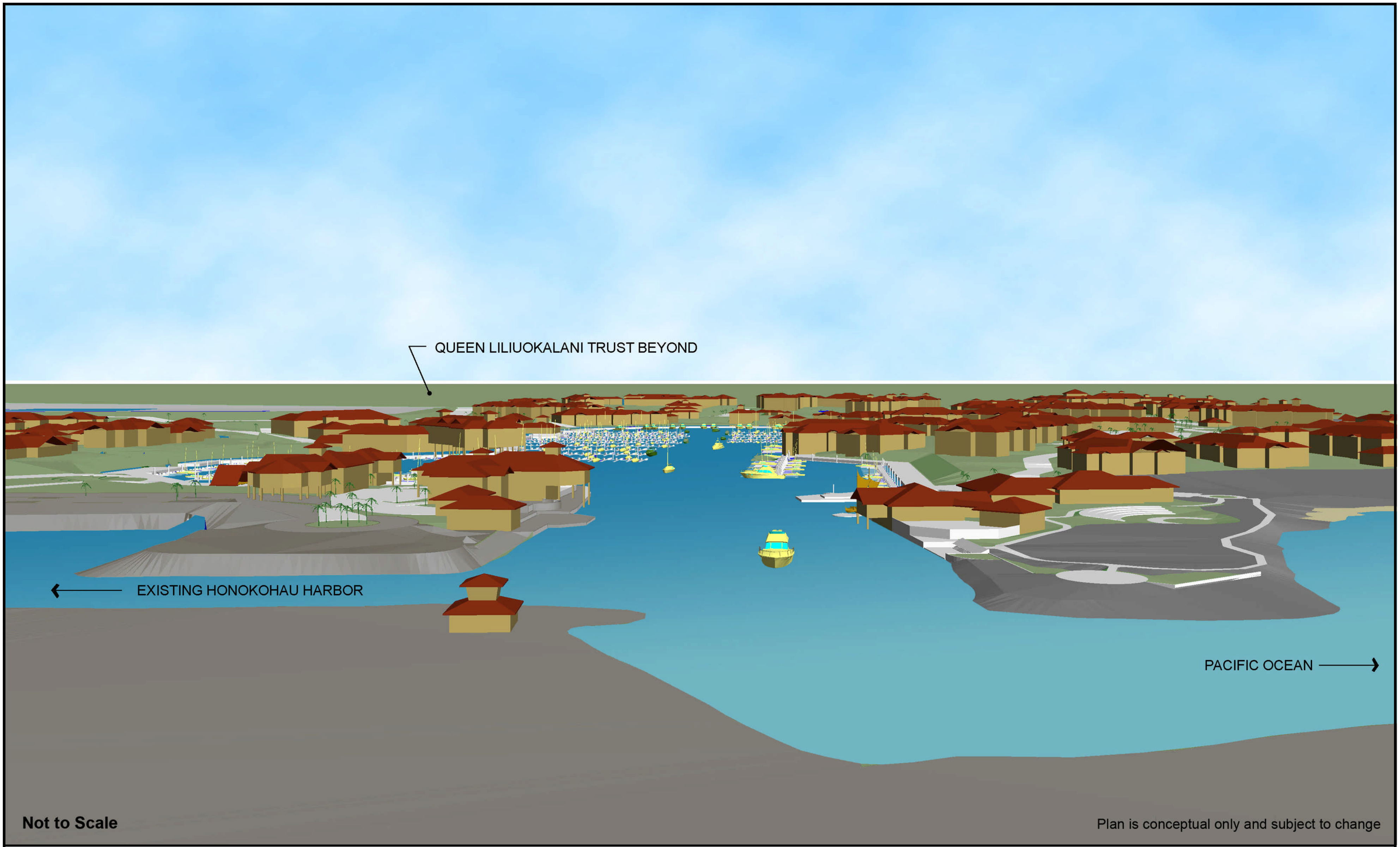

Figure U-3: View from North Side of Honokōhau Harbor Entrance Channel

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- Figure U-4: Close-up view from ocean of the coastline and makai parcels

  The view from the coastline shows a lava field that gently slopes up towards the Highway. As part of the development proposal, Kona Kai Ola's goal is to provide public shoreline access and connections to the coastal trail system. Greenways will be provided between the makai development parcels to preserve and complement the existing natural landscape. Within these wide areas will be vehicular access for public parking, passive recreation facilities such as barbecue and picnic facilities, and comfort stations to service users and hikers on the coastal trail system, which is being designed to be made part of the Ala Kahakai National Historic Trail system. They will also serve as view channels to the ocean from mauka areas of the Project. Mauka views from the shoreline are important view planes that are being maintained as part of this development.

- Figure U-5: View of the project from the ocean

  This gives an overall view of the entire project. The existing landscape is a barren lava field having the existing wastewater treatment plant and existing harbor and support buildings as the only developed areas. The National Historical Park and existing entry channel to Honokōhau Small Boat Harbor are to the left, with Alula Beach on the coast.

  The site gently slopes down from the highway to the ocean. The dark gray area at the coastline indicates a 400' shoreline setback, which will be left undeveloped with the exception of a coastal trail system. From the coastal trail, two lateral greenbelts provide public access to the shoreline and coastal trail system. Originating in Kailua-Kona, the coastal trail system will continue towards the Kaloko-Honokōhau National Historical Park, past the project site and cove beach, and terminate at the proposed Cultural Museum and park, with anchialine ponds and a heiau. As part of the marina development, water taxis will shuttle pedestrians across the marina, from the makai to the mauka. Pedestrian-friendly paths are integrated throughout the project to connect the development parcels with the commercial areas and the marina promenade. The existing wastewater treatment plant is seen in the background and will be buffered by a landscaped berm.

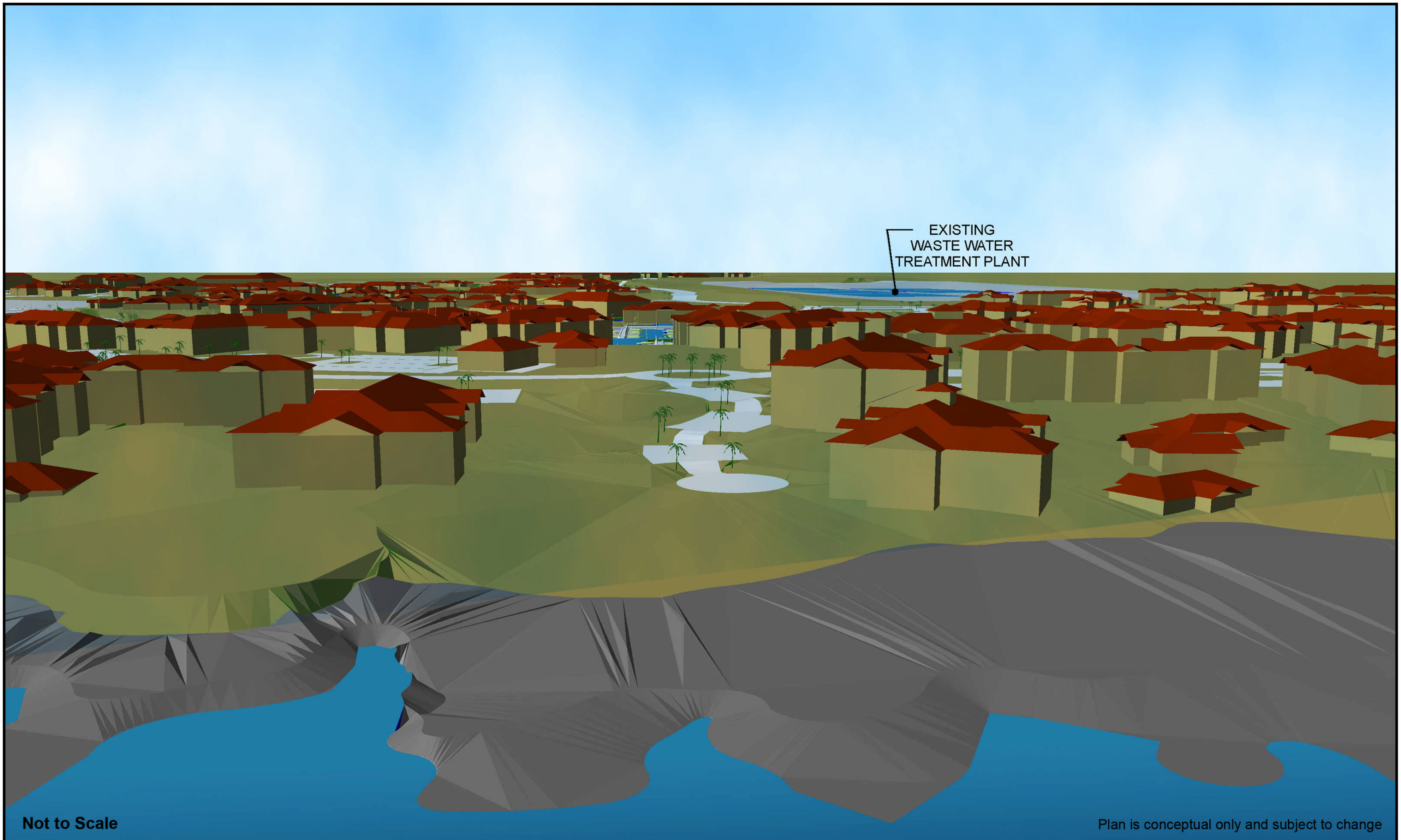

Figure U-4: Close-Up View from Ocean of the Coastline and Makai Parcels

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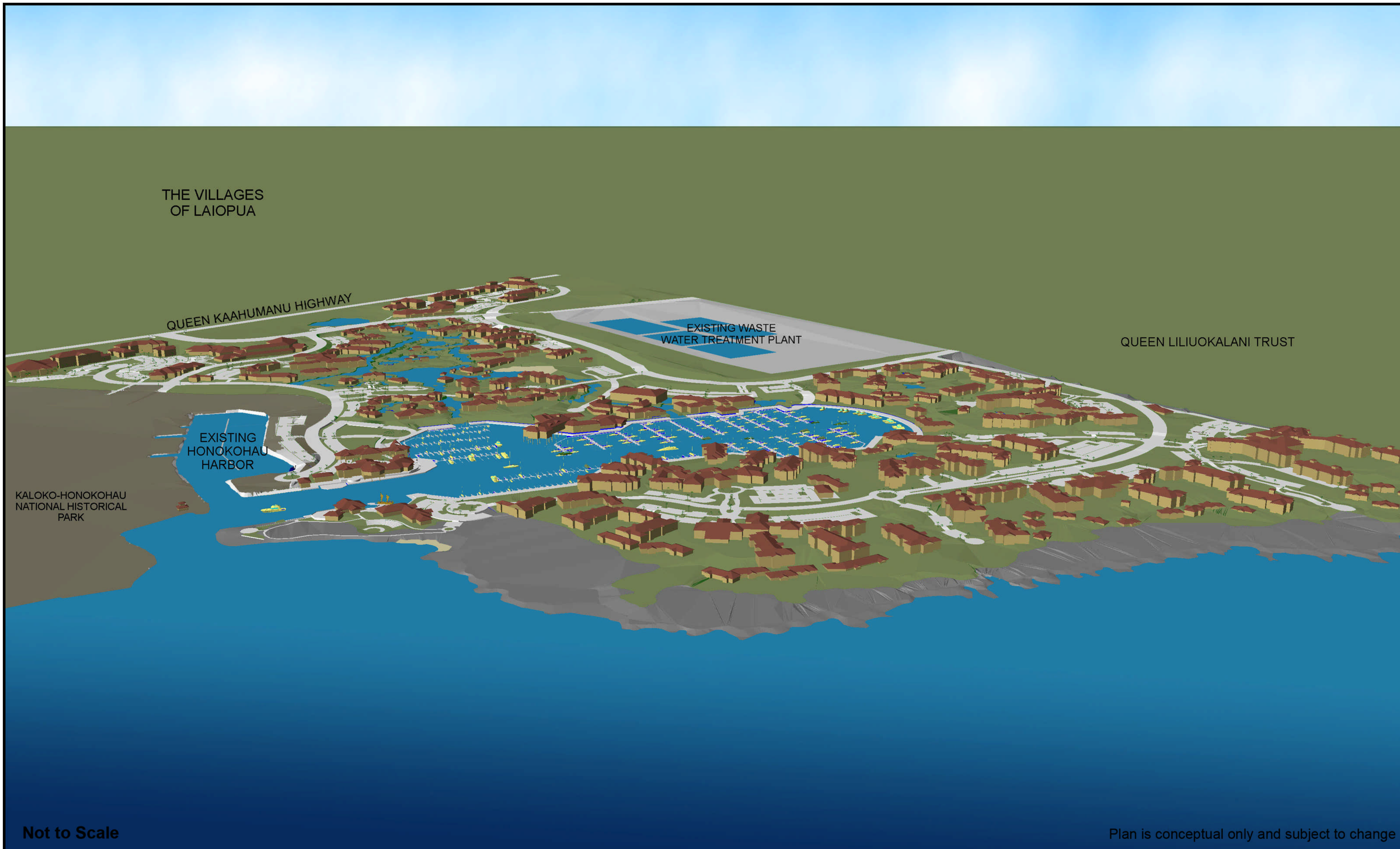

Figure U-5: View of the Project from the Ocean

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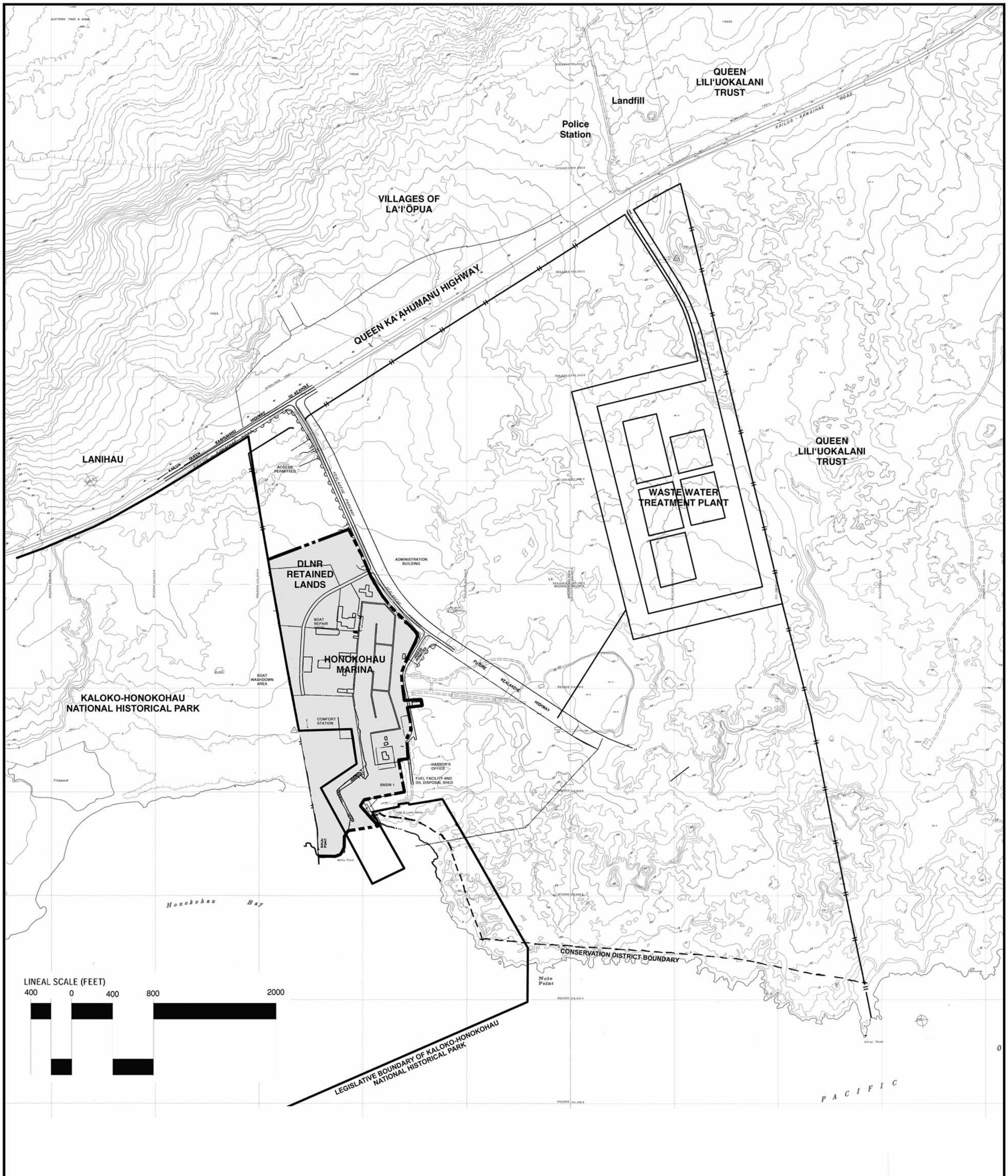
Attachment 4



Source: PBR HAWAII

Plan is conceptual only and subject to change

Figure J-2: Topography Map

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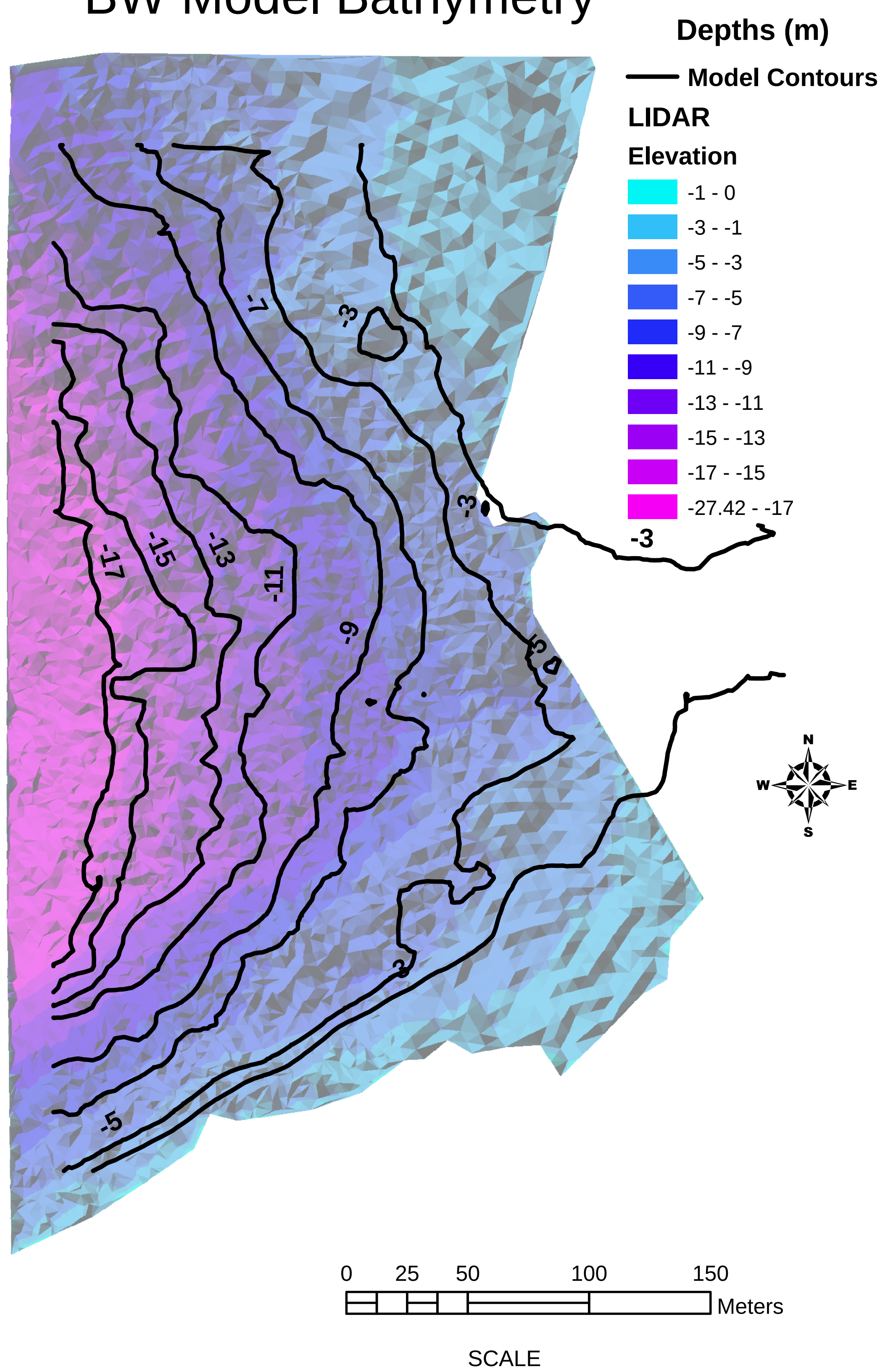
Attachment 5

Comparison Between Lidar Bathymetry and BW Model Bathymetry



Attachment 6

The conditions with the project constructed were found to be phosphorous limited. Several simulations were performed including and excluding the inflow from the marine exhibits which provides an additional nitrogen load and also varying the location of this inflow. It was found that the inflow from the marine exhibits can have a beneficial effect on flushing, especially when positioned within the existing harbor basin. However, its effect is significantly less than the effect due to the brackish groundwater inflow. When the exhibit inflow is excluded or positioned at the east end of the new marina, its effect is small in terms of flushing due to its high salinity. From a water quality perspective, since the loads from the exhibit inflow consist primarily of nitrogen, it does not cause increased algae growth. However, this exhibit inflow does raise the concentrations of ammonia and nitrate in the system.

Simulation results indicate that under the conditions when the post-expansion system receives an additional brackish inflow into the new 25-acre marina on the order of 30 mgd or more, water quality within the harbor system and in the surrounding waters remained similar to existing conditions. These conditions are expected to occur based on the findings reported by Waimea Water Services (2007), which states that the proposed marina would exhibit the same or similar flushing action as the existing marina.

An additional mitigation measure proposed by Waimea Water Services (2007), if sufficient inflow is not intercepted, consists of drilling holes in the bottom of the new marina to enhance this inflow and facilitate flushing within the proposed system.

~~3.9.3~~3.9.2 Anchialine ~~Ponds~~ Pools

Two studies on anchialine pools were conducted in this EIS process. The anchialine ~~ponds~~ pools water quality studies and ~~biota surveys were conducted by David A. Ziemann, Ph.D. of the Oceanic Institute and is~~biota surveys were conducted by David A. Ziemann, Ph.D. of the Oceanic Institute in October 2006 and are included as Appendix ~~G~~H-1. That survey included pools located both north and south of Honokōhau Harbor. In response to DEIS comments and to further study the pools south of entrance channel of Honokōhau Harbor, a second study was conducted by David Chai of Aquatic Research Management and Design in June 2007. The second survey focused on intensive diurnal and nocturnal biological surveys and limited water quality analysis of the southern group of anchialine pools exclusively. The report is contained in Appendix H-2.

~~3.9.3.1~~3.9.2.1 Existing Conditions

Anchialine ~~ponds~~ pools exist in inland lava depressions near the ocean. Two anchialine ~~pond~~ pool complexes are located immediately to the north and south of the Honokōhau Harbor entrance channel. The complex to the north is located wholly within the designated boundaries of the Kaloko-Honokōhau National Historical Park as shown in Figure Q~~O~~. Many of the ~~ponds~~ pools in the southern complex are within the park administrative boundary as well. ~~Ponds~~ Pools in the northern complex show little evidence of anthropogenic impacts. Many contain typical vegetation and crustacean species in high abundance.

Figure R locates anchialine pools near the harbor entrance and pools~~Ponds~~ in the southern complex are depicted in Figure S.

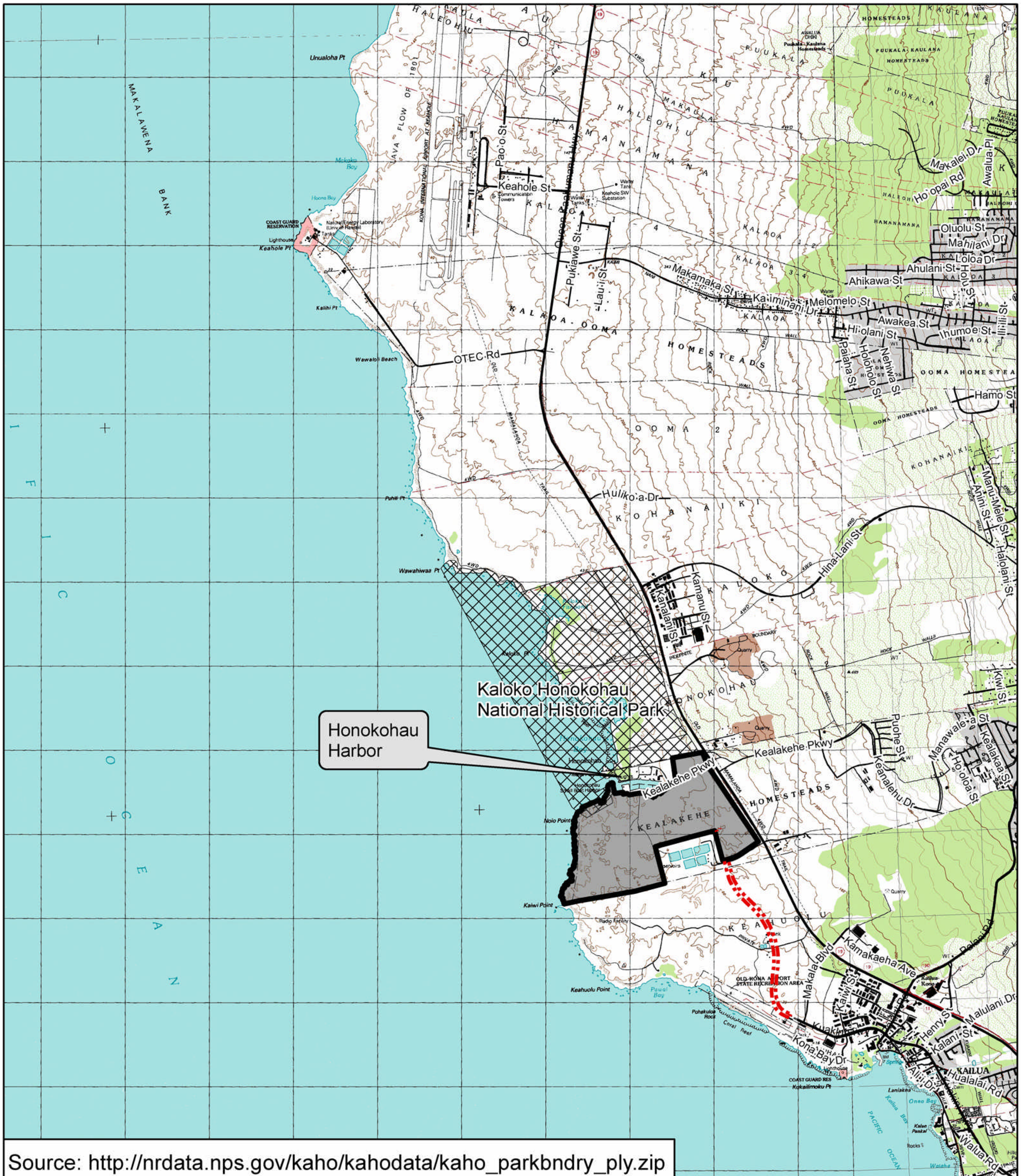


Figure Q: National Historical Park Service Legislative Boundary Map

Legend

- Project Site
- Proposed Parkway
- National Park Boundary

N
W E
S

0 2,500 5,000 Feet

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JDI
JACOBY DEVELOPMENT, INC.

Source: Oceanic Institute

Figure R: Anchialine Pool Locations

N
W E
S

0 2,000 4,000 Feet

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Source: Aquatic Resources Management And Design

Figure S: Anchialine Pool Locations in Southern Complex

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The 2006 study identified 22 pools in the southern complex. The 2007 study found that three of the 22 pools are part of an estuary complex with direct connection to the ocean. While there were several signs of direct human use and disturbance, such as trash receptacles and toilet facilities, the greatest degradation to the majority of the anchialine and estuarine resources was due to the presence of alien fish, including topminnows and tilapia, and introduced plants, predominantly pickleweed and mangrove. ~~are moderately to heavily impacted, with many containing exotic fish that exclude the anchialine crustaceans. The ponds also show evidence of human impact, including discarded bottles, cans, wrappers, diapers, toilet paper, etc. Water quality conditions within the ponds generally reflect the conditions of the underlying groundwater.~~

~~Figure P locates anchialine ponds near the harbor entrance. The study conducted as a part of this EIS show that the anchialine ponds south of the harbor entrance are moderately to heavily impacted by human activities and introduced fish populations. The study found that the nitrogen phosphorus concentrations in these ponds are significantly higher compared to the ponds north of the harbor entrance. The sources of these additional nutrients are not known. Continuous influx of nutrients will eventually degrade the water quality to levels that could alter the pond ecology.~~

Biota surveys in the two pond systems clearly indicate that counts of typical pond denizens show a remarkable difference between the northern and southern ~~ponds~~ pools. In the northern ~~ponds~~ pools the number of *Halocaridina rubra* ranged from a low of 20–25 to too numerous to count. The biota rich pond bottoms appeared red due to the *Halocaridina rubra* numbers. The only other species visible was the predatory shrimp *Metabetaeus lohena*. In contrast, only four out of the 22 ~~ponds~~ pools examined in the southern pond complex showed a decreased presence of *Halocaridina rubra* (6 to 200) individuals in the pond, and three ~~ponds~~ pools contained *Metabetaeus lohena*. Eight of the ~~ponds~~ pools contained numbers of introduced minnows which is an apparent predator of *Halocaridina rubra* and *Metabetaeus lohena*.

The 2007 study found three of the pools identified in the 2006 study were part of an estuary complex with direct connection to the ocean, and that the southern complex contained 19 anchialine pools. The study further found that a majority of the southern pools are degraded biologically and physically, primarily due to the effects of introduced fish and plant species. Six pools are currently devoid of alien fish, but they face a high level of threat due to the proximity of pools that have these species. Of the 19 anchialine pools, six were considered high tide pools (exposed only at medium or high tide), seven were considered pool complexes (individual pools at low tide and interconnected at high tide), and six were single isolated pools. Of the 19 anchialine pools, three pools with a combined surface area of $20m^2$ would be eliminated due to the harbor construction.

The DEIS presented information stating that harbor construction would cause an increase in salinity in the anchialine pools makai of the proposed marina basin to become equivalent to the ocean at 35 ppt. and that the anchialine biology would then perish. There is currently a level of uncertainty by professional hydrologists as to the exact movement of surface groundwater and final determination of anchialine salinity following the harbor construction. The assessment that all anchialine pools will be barren with the construction of the harbor may be premature. *Halocaridina rubra* (opae ula) are routinely drawn from high salinity wells at 30-32 ppt.

Within the 19 pools, native and non-native fauna included 14 species comprised of 5 fish, 2 mollusca, and 6 crustacea. Algae within the pools primarily consisted of a mixed assemblage of diatoms and cyanobacteria, with several pools dominated by matted filamentous *Cladophora*, sp. The darker cave/overhang pools and high tide pools had epilithic *Hildenbrandia* sp. covering the rock substrate. Riparian vegetation was dominated by introduced species consisting of Pickleweed (*Batis maritima*), Mangrove (*Rhyzophora mangle*), and Christmasberry (*Shinus terebenthifolius*). Only two species of native plants Akulikuli (*Sesuvium portulacastrum*) and Makaloa (*Cyperus laevigatus*) existed near the pools and comprised only few small patches and a single tuft (respectively).

Most of the hypogeal anchialine shrimp have adapted to the presence of minnows by foraging in the pools at night. During daylight hours, only the adult shrimp appear to coexist at low population levels with the smaller *P. reticulata*, but the larger *G. affinis* and *Oreochromis* prevent the daytime appearance of hypogeal shrimp due to predation.

The average salinity in Kealakehe pools is relatively high at 13.5 ppt compared to most other pools along the West Hawai‘i coastline, having an average of approximately 7 ppt. This high salinity appears to be characteristic of this region, and is similar to the average of most pools within the adjacent ahupua’a of Honokōhau and Kaloko. The levels of nitrate-nitrogen levels are relatively high compared to other undeveloped areas, but fall in the range of some developed landscapes. Other water quality parameters, including pH and temperature, fall into normal ranges for anchialine pools.

This relatively high salinity is the likely reason aquatic insects were not found in any pools at Kealakehe. Though the rare damselfly *Megalagrion xanthomelas* has been observed and collected from Kaloko, a statewide assessment of its range has not found it to occur in water with salinity greater than 3ppt. However, there has been an unsubstantiated occurrence of the nymph in a pool of up to 8ppt (Polhemus, 1995).

Another species of concern is the hypogeal decapod shrimp *Metabetaeus lohena.* These shrimp are sometimes predatory on *H. rubra* but are more often opportunistic omnivores similar to *H. rubra.* Predusk and nocturnal sampling at high tide is clearly the optimal method to determine habitat range and population densities for this species. These shrimp were found in 13 of the 19 pools, 7 of which had *M. lohena* only at night. The occurrences of *H. rubra* were found in 16 of 19 sampled pools, 8 of which had ‘Ōpae‘ula observed only at night. Consequently, despite having numerous degraded anchialine resources at Kealakehe, there are opportunities for many of the pools to be restored and enhanced to a level where large populations of anchialine shrimp and other native species may return to inhabit the pools as they likely have in the past.

~~As mentioned earlier, the southern ponds also had elevated concentrations of nutrients indicating water quality degradation. These factors indicate that if no restoration or maintenance activities are instituted to reserve these ponds, these ecosystems will degrade beyond recovery.~~

~~3.9.3.2~~3.9.2.2 Anticipated Impacts and ~~Recommended~~ Proposed Mitigations

The anchialine ~~ponds~~ pools that are located north of the existing harbor are not likely to be impacted because no development activities are proposed north of the existing harbor. It is highly unlikely that existing groundwater flows to the Kaloko-Honokōhau pond system to the north of the existing harbor will be impacted by the proposed marina to the south.

Of the 19 pools in the southern complex, three would be eliminated due to harbor construction. Regarding the remaining pools, the DEIS noted that t~~T~~he change in the local groundwater flow pattern in the vicinity of the proposed marina ~~will~~ would impact the anchialine ~~ponds~~ pools that are located between the proposed marina and the shoreline south of the harbor entrance. The 2006 study (Appendix H-1) noted that t~~T~~he salinity of the anchialine ~~ponds~~ pools ~~will~~ would increase due to reduction of brackish groundwater, and that ~~. Some ponds will be excavated to make the new harbor basin. T~~those ~~ponds~~ pools that are not excavated will revert to full salinity, causing the loss of their habitat. ~~and associated aquatic flora and fauna. However, current investigations indicate that these ponds are already enriched by nutrients and the density of associated aquatic fauna is very low. In addition, trash from visitors, and introduction of minnows has already degraded the pond ecology.~~ Even without the potential impacts from the proposed marina construction, the pond ecology might change irreversibly from the nutrient input, human indifference and expansion of non native fauna species.

Further studies conducted in response to DEIS comments (Appendix H-2, and Appendix G-3) indicate that the remaining pools may not increase in salinity to levels unhealthy for *H. rubra* and *M. lohena* and other anchialine pool fauna. In addition, these studies determined that there are realistic mechanisms employed elsewhere that would mitigate changes due to groundwater changes. Waimea Water Services found that harbor construction would cut off some of the fresher ground-water flow. However, predicting the extent of change in flow is difficult if not impossible even with numerous boreholes and intense sampling. The actual flow of groundwater towards the sea is minimal today, and tidal measurements show that tide fluctuations represent more than 90 percent in actual harbor tides. The fluctuations occur simultaneous with the ocean/harbor tide, which indicate a vertical and horizontal pressure regime between bore hole 6 and the ocean and harbor. Hence, the tides alone create a mixing system that increases salinity, as the flow approaches the point of discharge which will be either the channel or the shore.

Another factor that could influence groundwater quality is the increased local recharge from irrigation between the channel and shore. This will add fresh water to the lens locally but is not quantified at this time.

Quantification of these impacts, including the flow of groundwater through each pond, is extremely difficult. The shallow lavas are of the pahoehoe type and have a relatively high horizontal permeability. In surface depressions or undulations, the pahoehoe lavas have a tendency to lose vertical permeability from sedimentation thus restricting water exchange within the individual pools. This is normally reflected in both the salinity and temperature and this information has been adequately studied in the pools.

Changes in groundwater quality may or may not impact biological communities in the anchialine and estuarine environment. In either case, it is important to understand these relationships to effectively manage the resource. If there is significant deviation from the baseline especially in regard to nutrients, pathogens, and toxins, a mitigation plan to determine the cause and take decisive appropriate action will be implemented. The mitigation plan will be based on the following objectives:

Objective 1 To preserve, maintain, and foster the long-term health and native ecological integrity of anchialine pools at Kealakehe.

Objective 2 To protect and promote cultural practices and traditions surrounding anchialine resources at Kealakehe.

Objective 3 To provide education, interpretation, and interactive opportunities for the community to learn about and appreciate the anchialine resources.

Objective 4 To acquire a pond manager to implement the program, conduct monitoring, research, and reporting, and provide education to the community about anchialine and estuarine resources.

Mitigation measures to facilitate the long-term health of the remaining anchialine pools will be based on environmental monitoring, which is vital as an early warning system to detect potential environmental degradation. A series of quantitative baseline analysis of the physio-chemical and biological components within the project site will provide a standard by which the effects of the development, anthropogenic activities, and natural phenomena on the environment can be measured. The framework for the mitigation plan will include three measures intended to meet these objectives, including bioretention, salinity adjustment and possible new pools.

As a mitigation measure, bioretention, which is a Best Management Practice (BMP) is a feasible application for the proposed development. There is a probability that nutrients and other potential pollutants will runoff landscaping and impermeable surfaces such as roadways and parking lots during medium or high rainfall events. Some of these pollutants could enter the groundwater table and into anchialine pools and ultimately the ocean. As an alternative to directing runoff into the ground through drywells, storm water should be directed into bioretention areas such as constructed surface or subsurface wetlands, vegetated filter strips, grass swales, and planted buffer areas. Storm water held and moved through these living filter systems are essentially stripped of most potential pollutants, and allowed to slowly infiltrate back to the groundwater table.

Bioretention is a Best Management Practice (BMP) that would be a highly appropriate application for the proposed development. Further, BMPs utilized in series may incorporate several storm water treatment mechanisms in a sequence to enhance the treatment of runoff. By combining structural and/or nonstructural treatment methods in series rather than singularly, raises the level and reliability of pollutant removal. Another means to reduce the potential for groundwater contamination is to increase soil depth above the standard in landscaped areas. This will allow chemicals to be held in the soils longer for more complete plant uptake and breakdown of these chemicals by soil microbes. A specific guide for chemical application by landscape maintenance personnel will be a beneficial tool to help avoid contamination of groundwater resources.

Another mitigation measure that may be included in the management plan is salinity adjustment. In the 2006 assessment regarding the impact to the southern pools from the proposed construction of the harbor, it was stated that this construction would cause the salinity in the anchialine pools to become equivalent to the ocean at 35ppt. It was then concluded that the anchialine biology would perish.

However, there is currently a level of uncertainty by professional hydrologists as to the exact movement of surface groundwater and a final determination of anchialine salinity following the harbor construction. The dynamics of groundwater movement through a porous lava medium both seaward and laterally along the coastline is an inexact science. This is compounded by the variations in water density, including stratification of salinity within the proposed harbor and capillary movement of low-density surface water through the substrata.

The assessment that all anchialine pools will be barren with the construction of the harbor may therefore be premature. *H. rubra* are routinely drawn from high salinity wells at 30 – 32 ppt and survive in this salinity for years. Further, high populations *H. rubra* and *M. lohena* have thrived and reproduced in pool salinities of 27ppt. If the pools do become full strength seawater at 35ppt, there exists uncertainty on the long-term effects to anchialine organisms, since there are no long-term studies or examples of native anchialine ecosystems at 35ppt. Native anchialine pool vegetation also has relatively high salinity tolerance.

If the salinity were expected to rise to 35 ppt, possible mitigation in the management plan will include methods to surcharge man-made anchialine pools created adjacent to or in the vicinity of natural pools with low salinity well water. If sufficient volume is used, it is theoretically possible to lower salinity in adjacent natural anchialine pools. This surcharge method has been successfully used to raise salinity in anchialine pools and cause the salinity rise in adjacent pools of at least up to 10 meters away. Surcharging with low salinity should work as well or better since the lower density water will essentially float atop the higher salinity water at the surface layer, and move throughout the complex of natural pools. Surcharging may also be a viable mitigation to dilute and more rapidly disperse any pollutants that may be detected in the pools.

Another mitigation measure includes the creation of new anchialine pools. There is significant opportunity to create new anchialine pools and greatly expand the native habitat and resource. It has been demonstrated at several projects in West Hawai'i that anchialine pools can be created and will be colonized with a full compliment of anchialine species endemic to the area. Anchialine pools are considered focal points of higher productivity relative to the subterranean groundwater habitat around them. Their productivity promotes an increase in population levels of anchialine species within the pools themselves and throughout the subterranean habitat surrounding them.

~~No realistic mechanisms are envisioned for re-injecting fresh water into these systems to maintain their ecological balance as an anchialine system. These ponds will be changed from a brackish water system to a marine system. But, those ponds in the area of the shoreline park and cultural park will be cleaned of vegetation and protected from other physical alteration. A buffer zone around these newly established marine ponds will be protected as well.~~

~~The anchialine pond shrimp (*Metabetaeus lohena)* and the orangeback damsel fly (*Megalagrion xanthomelas)* are listed as candidate endangered species in the Federal Register and were both recorded in surveys of these anchialine ponds done in 2004 by US Geological Survey Biological Resources Division and the NPS Inventory and Monitoring Program. Low numbers of *Metabetaeus lohena* were encountered in three of the 22 ponds surveyed in the southern pond complex. *Megalagrion xanthomelas* was not encountered in any of the southern pond complex ponds during the recent study. The low density of *Metabetaeus lohena* and the observed absence of *Megalagrion xanthomelas* may be due to the impacts from high nutrient input and general degradation of the ponds.~~

~~An attempt should be made to move as much of the existing population of *Metabetaeus lohena* from these anchialine ponds before they become too saline, to possible newly excavated ponds that may be developed off-site. These shrimp should not be introduced into existing populated ponds to avoid any potential pathogenic impacts to the healthy ponds.~~

~~Public education on the unique ecology of the anchialine ponds and the need for preserving their ecology will reduce future human impacts in other healthy ponds.~~

~~Further recommended mitigation includes restoration to degraded anchialine ponds off the project site, preferably those located at the adjacent Kaloko-Honokōhau National Historical Park.~~

Attachment 7

An Inventory And Assessment Of Anchialine Pools Including Management And Mitigation Recommendations For The Kona Kai Ola Project, Kealakehe, Hawaii

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June 14, 2007

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Introduction

Jacoby Development, Inc. is proposing to develop approximately 530 acres of land in lower Kealakehe, North Kona, on the Island of Hawaii. The development will consist of mixed urban, resort, and commercial facilities. Included in the plan will be an 800 slip marina and associated boating facilities, a seawater lagoon, and open space. One area planned for protected open space contains a number of anchialine pools, archaeological sites and an estuarine habitat.

1.0 Study Background and Purpose

In 1973 L.B. Holthuis originated the term anchialine pool which citation protocol dictates to be the proper term. Two anchialine pool surveys were conducted at Kealakehe to determine the existing water quality and biological conditions, probable impacts, and mitigation measures necessary to minimize potential adverse effects. The first survey was conducted in April of 2006, and included a biological survey and detailed nutrient analysis of anchialine waters. That survey, included pools located both north and south of Honokohau harbor. The second survey was conducted in May 2007, and focused on intensive diurnal and nocturnal biological surveys and limited water quality analysis of the southern group of anchialine pools exclusively. This southern group in the vicinity of Alula cove was selected for a second survey, as they are more likely to be impacted by the proposed Kona Kai Ola development project. The information and recommendations presented herein are drawn from both surveys as well as published literature on anchialine system and their management, consultation with others involved with anchialine pool research and management, and 17 years of applied anchialine pool and wetland management by this author.

This study was contracted by Oceanit Laboratories, Inc. to conduct intensive field surveys incorporating 2 diurnal and 2 nocturnal samplings during higher high tide periods. The survey will provide a current assessment of the contents and state of anchialine pools in the project area. Of particular concern is the potential for adverse ecological effects on anchialine resources due to the proposed harbor expansion and from construction activities and operations. Consequently, this paper will examine other anchialine systems that contain similar attributes, which have faced similar development situations. Based on an aggregate of existing data and information, this document will address possible management and mitigation measures.

2.0 Anchialine Pools as an Ecological Resource

2.1 Background

Anchialine pools are isolated coastal exposures of the groundwater table occupying depressions in historic or recent prehistoric lava flows and porous limestone depressions. These pools contain mixohaline water, and although lacking surface connection to the sea, their water levels exhibit damped tidal fluctuation indicating a subsurface connection to the ocean. Since these pools exist in low lying coastal depressions, in some cases shallow pools may disappear during low tide, which restricts the colonization of certain organisms. Conversely, some pools that were apparently isolated at low tide coalesce during high tide, forming larger singular pools, and are considered pool complexes with homogeneous biological and water chemistry characteristics. Many of the sampled pools at Kealakehe fall into these two categories. Anchialine pools are rare among aquatic ecosystems and geographically limited in the United States to Hawaii. It is estimated that nearly 700 pools exist in Hawaii, most of which occur along the west coast of Hawaii Island between Kawaihae and Kailua-Kona. The ecological significance of Hawaii's anchialine pools owes primarily to their role as habitat for a variety of unique flora and fauna. Their biota is distinctive in community structure and species endemism. Two classes of organisms are found in anchialine pools, epigeal and hypogeal species. The former require illuminated water and are often common to other coastal aquatic habitats, while hypogeal species spend a substantial portion of their life in the dark, which in anchialine systems corresponds to the subterranean interstices within the groundwater table.

2.2 Threats to Anchialine Resources

Anchialine pool ecosystems in West Hawaii are under increasing threat of degradation due to a number of factors. The single greatest threat is the introduction and spread of alien fish and plant species. A lesser threat is groundwater contamination. The effects of alien fish in anchialine pools is rapid senescence, both directly due to predation and competition, and indirectly through a change in the pools trophic ecology, predominantly due to the loss of primary consumers and detritivores. Combined, these changes accelerate eutrophication, sedimentation, infilling, and ultimately the demise of the pool. This altered condition is exacerbated when groundwater contamination in the form of chronic high nutrient levels is present and flushing rates are reduced, promoting rapid filamentous chrysophyte and chlorophyte production. In addition, elevated nutrients promote higher growth rates of terrestrial and riparian vegetation. Large or dense vegetation around pools add leaf litter and increase root mass within groundwater interstices around pools, which decrease water exchange, adding to the senescence process.

In anchialine systems that contain intact native biota, adequate flushing, and physically maintained riparian vegetation, elevated nutrient levels have little or no observable effect on the stability of the system. Anchialine systems are typically high in dissolved nutrients (relative to the ocean) from natural and anthropogenic sources, and inorganic nutrients in

anchialine pools vary among locations and may be as high or low in developed coastal areas as in pristine undeveloped areas. (Brock and Norris, 1988, Brock and Kam, 1997). Pools with native aquatic fauna dominated by *Halocaridina rubra*, a small red caridean shrimp most often associated with anchialine pools, usually have a compliment of lower order crustacea, mollusks, and microfauna. Most substrates in the sunlit pools are blanketed with cyanophytic crusts or epilithon, and interspersed with low-cropped filamentous chlorophytes. It is this complete diverse and rich ecology that prevents filamentous and matted algae from dominating and overwhelming a system. Consequently, healthy anchialine ecosystems in developed and undeveloped coastal areas remain intact even when faced with elevated dissolved nutrient concentrations from natural or anthropogenic sources (Brock & Kam, 1997, Chai, personal observation).

2.2.1 Salinity Levels and Effects in Anchialine Systems

In a 1974 study by Maciolek and Brock, 298 pools along the leeward coast of Hawaii Island were inventoried, and contained salinities of less than 15ppt for 93% of them. They ranged from 1ppt -30 ppt, with the average being 7ppt. Variations in salinity were seldom less than a few parts per thousand (Maciolek and Brock, 1974). However, salinity along the vertical gradient exhibits much more variation among locations along the West Hawaii coastline. For example, within the ahupua'a of Kawaihae, a salinity of 25ppt is reached at an average depth of approximately 18 meters below sea level within 100 meter of the shoreline. At Ka'upulehu, within the same distance of the shore a salinity of 25ppt is reached at approximately 6.8 meters, and Opaeula are drawn from wells over 18 meters below sea level with salinities averaging 31 ppt. Of the hundreds of anchialine pools observed and documented by this author and other anchialine pool researchers, *H. rubra* and *Metabetaeus lohena* are seldom observed in pools with salinities higher than 25 parts per thousand (ppt). These high salinity pools typically have a high level of connectivity to the ocean, and this connection often allows a variety of predatory and competitive marine and euryhaline fish and crustacea to access these anchialine pools and deplete or eliminate hypogeal shrimp.

At Hualalai Resort in Ka'upulehu, North Kona, Hawaii, moderate to high salinity fluctuation in anchialine pools has exhibited no apparent adverse changes to the anchialine ecology, even when facing salinity changes of up to 23 ppt. Two large man-made anchialine pools (1.4 million and 65,000 gallons) and a natural pool enlarged from 1,000 gallons to 40,000 gallons, were created in 1993 and all were surcharged in 1995 with high salinity well water to 27ppt in an attempt to stop the growth of a filamentous algae, *Melosira sp.* and *Cladophora sp.* These two types of algae are pioneer species in newly created or dramatically disturbed anchialine pools that lack the benefit of an adjacent healthy anchialine ecosystem to seed them. The strategy worked to eliminate filamentous algae, and during the first four years, the largest pond contained tens or hundreds of millions of *H. rubra* and millions of *M. lohena* that were especially abundant at night. The decline of these populations was gradual as marine fish were introduced to the pool, and eventually the hypogeal shrimp were observed only at night. The 65,000 gallon man-made anchialine pool located approximately 200 meters away was also surcharged to 27ppt for approximately 1 year until a stable anchialine ecosystem was developed, allowing the surcharge system to be turned off. The pool reverted back to 6ppt and the ecosystem remained intact with dense populations of many anchialine organisms. In subsequent years, the pool was surcharged for a few weeks during the spring and fall to clarify the water during *Enteromorpha* sp. sporulation, with no apparent adverse effects. The enlarged natural pond (40,000 gal.) contained a salinity of 2-4ppt, and supported indigenous widgeon grass (*Ruppia maritime*) and an extremely dense population of *H. rubra* and *M. lohena*. It was surcharged on a periodic basis to 20ppt to eliminate alien Dragonfly larvae and Bufo tadpoles, the presence of which result in the decline and disappearance of hypogeal shrimp. This dense and stable community of native species in both pools existed for 11years until Minnows (*Poecilia sp.* and *Gambusia sp.)* were introduced to the pools in 2005, which devastated their ecology within 6 months. The anchialine pools that were untouched or enlarged, containing an intact native ecology, have remained intact since prior to the construction of the Resort.

2.2.2 Dissolved Nutrients in Anchialine Systems

Various scientists have measured groundwater nutrient concentrations from undeveloped sites in West Hawaii, over time. Brock has reported that nitrate nitrogen in these pools ranged from 280ug/l to 2800ug/l and orthophosphate ranged from 6.2ug/l to 201ug/l (Brock and Kam 1997). Kealakehe pools fall in the higher range in regard to dissolved nitrate nitrogen, having values between 1664ug/l to 2960ug/l with an average 2027ug/l. Orthophosphate ranged from 14ug/l to 32ug/l, averaging 21.6ug/l (Ziemann, 2006), which fell in the lower range compared to other undeveloped sites. Nutrient levels in man-made, modified, and natural pools at Ka'upulehu (a developed area) were recorded between 1989 prior to construction in 1994, and through to 2000. The pools contained nitrate nitrogen levels averaging 2106ug/l prior to construction and 2749ug/l during and after construction. Orthophosphate level prior to construction, averaged 154.4ug/l, while during and after construction orthophosphate levels averaged 149.7ug/l. The highest concentrations of nutrients in the pools occurred during the grow-in period of the landscape and following high rain events. Similar to the findings of Brock at Waikoloa, no apparent adverse effects were observed in healthy anchialine pools. However, disturbed or newly created pools began the process of eutrophication with heavy growths of *Cladophora sp.* until they were cleaned of all sediment and algae, surcharged with high salinity well water, and manually seeded from healthy pools and naturally recolonized with native biota.

There has been a great deal of research conducted since the 1980's by Brock on anchialine pools at Waikoloa and around the State. A good summary assessment on the effects of alien species, high nutrient concentrations, and other types of groundwater contamination on anchialine pools, can be found in Brock and Kams 1997 study entitled "Biological and Water Quality Characteristics of Anchialine Resources in Kaloko-Honokohau National Historical Park" (Brock and Kam, 1997). This study also examines a number of Management recommendations for the Parks pools that may apply to the anchialine resources at Kealakehe.

3.0 Anchialine Pools as Cultural Resource

In addition to their ecological value, anchialine pools are of significant cultural importance. Hawaiians of the past relied on anchialine resources for their livelihood and survival, and maintaining the health of these systems was of high importance. Hawaiian historians, who speak of the anchialine pools within the arid lands of West Hawaii, describe these pools as being a source for drinking and cooking water, bathing, irrigation, and aquaculture. Individual pools typically had a specific use and were well maintained.

Of particular importance were anchialine pools as habitat for Opaeula (*Halocaridina rubra*). Fishermen would gather hundreds of these shrimp into small balls which were sometimes mixed with fine red cinder to add bulk, and they would set out in their canoes to specific areas in the ocean where Opelu (Mackerel Scad, *Decapterus macarellus*) would gather in schools called a Ko'a Opelu. The balls of shrimp would then be released among the Opelu and nets would be set to harvest the fish as they fed upon the shrimp. During the Kapu seasons when Opelu fishing was not allowed, the Ko'a Opelu would continue to be fed and maintained as an early form of open-ocean farming or ranching. (H. Springer, L. Lightner, and C. Torres, pers. comm.) Some fishermen today practice the same fishing technique, and rely on a stable source of Opaeula to catch Opelu. The importance of this fishing tradition cannot be understated. Today, Opelu are not only a highly valued source of food, but they and the fishing methods surrounding them, continue to be a direct link to Hawaiian culture, values, and traditions of the past. The anchialine pools at Kealakehe offer a unique opportunity to help continue this tradition. Further study on the cultural use of anchialine pools of Kealakehe, Honokohau, and Kaloko by early Hawaiian inhabitants should be undertaken and incorporated into the final management plan.

4.0 Findings and Recommendations

The study site was comprised of 19 anchialine pools. Of the 19, six were considered high tide pools (exposed only at medium or high tide), seven were considered pool complexes (individual pools at low tide and interconnected at high tide), and six were single isolated pools. Three of the anchialine pools identified by Ziemann in the 2006 study were considered part of an estuary complex with direct connection to the ocean. Location, physical characteristics, aquatic macrofauna, and floral communities were recorded during higher high tide.

There were several signs of direct human use and disturbance in the pools such as trash receptacles and toilet facility. However, the greatest degradation to the majority of the anchialine and estuarine resources was due to the presence of alien fish, including topminnows and tilapia, and introduced plants, predominantly pickleweed and mangrove.

Figure 1. Location of Anchialine Pools and Estuary at Kealakehe

4.1 Survey Approach and Method

The field survey approach for anchialine pools at Kealakehe was based on recommendations made by John A. Maciolek, one of the pioneers in anchialine pool research (Maciolek, 1987). The survey was conducted on May 20th and 21st, 2007, and all pools were visually inspected each day and night at or near mean higher high tide periods. Since the inventory of aquatic fauna was of primary importance, intensive surveying was necessary during nocturnal high tides, a period conducive to anchialine faunal activity. Estuarine fauna were also recorded both days and nights as part of this study.

Temperature, salinity, oxygen and pH, were measured with an YSI model 556 multi-parameter meter, and were taken in all pools during higher high tide. These four parameters were selected because they are essential limiting factors governing populations of aquatic organisms in the anchialine biotope (Maciolek pers. comm.). All pools were less than 1 meter deep so all measurements were taken at or near the bottom of pools where water quality exhibits the most stability. Specific ions are also important factors to be considered in an aquatic ecosystem but were beyond the scope of this study. A water analysis and monitoring program is addressed later in this paper. Other physical parameters were recorded at higher high tide, and included surface water dimension, average pool depth, type of pond feature (i.e. crack, low lying depression, collapsed lava tube, etc.), and sediment depth and composition. All observed aquatic fauna was recorded and a relative abundance rating attributed to their numbers. Quadrat sampling was not used since both hypogeal shrimp species often occur in groups or clusters in a specific area of the pool. Consequently, a physical quadrant count may not be representative of the entire pool or pool complex for short-term analysis. However, long-term monitoring should involve more quantitative analysis using fixed sampling points. Riparian vegetation was a dominating feature of many Kealakehe pools and was noted in this study. Anchialine pool and estuary sites were recorded on a U.S. Geological Survey topographic map.

4.2 Survey Results

A taxonomic list of aquatic fauna observed is presented in Table 1, and includes their occurrence in each of the 19 pools and a relative abundance rating. Table 2 indicates the individual pools physical, water quality, substrate, and riparian vegetation characteristics.

Table 1. A list of aquatic fauna and their relative abundance in individual pools and pool complexes. A (n) suffix indicates organisms were observed only at night.

Abundance Rating:
1 = Less than 3 individual observed.
2 = several individuals observed or uncommon occurrence relative to other pools
3 = Common occurrence with many individuals observed relative to other pools
4 = Abundant throughout the pool or pool complex and/or numerous individuals occurring in groups.

Pool	1	**2**	3	**4**	5	**6**	**7**	**8**	**9**	**10**	11	12	13	14	15	16	17	18	19
Group/taxon																			
Mollusca																			
Theodoxus cariosus	4		2	2	2				1		2			2	3				4
Melania sp.											2			3	2			3	
Crustacea																			
Halocaridina rubra				3	2n	3	3	3	2n	3	2n	1n	2	3n	1n	2	2n	3	2n
Metabetaeus lohena				2	2n	2	2	3	2n	4			3n	2n	3n	3n		3	2n
Macrobrachium grandimanus	3	3			1				2		1			1n					
Metapograpsus thukuhar	3	1	2	3	2				2				1				1		2
Paryhale sp.				2															
Fish																			
Gambusia affinis	3		3		2						4	3		4	3		4		4
Poecilia reticulata	2		2		2						3	3	4	3	3	2	4	2	3
Oreochromis sp.														4	2				3
Gobidae sp.	1																		
Neomyxus sp.															1				

Table 2. Physical and water quality characteristics of anchialine pools at Kealakehe.

	Area	Depth	Sediment	Temp.		Salinity	D.O.	
Pool	m2	cm	Depth cm	ºC	pH	ppt	ppm	Description
1	16	50	<1	22.3	7.25	13	6.6	Collapsed lava tube rock-rubble substrate
2	20	74	<3	21.4	7.47	13.6	7.1	Collapsed lava tube rock-rubble substrate
3	40	53	<6	21.8	7.4	13.3	7.2	95% *Batis* filled depression complex, 3 open pools. Biogenic sediments
4	16	37	<1	22.3	7.38	13	7.4	80% *Batis* filled depression complex, 5 open pools
5	20	50	<1	22.6	7.39	14.2	7.3	90% *Batis* filled crack complex, 3 open pools
6	9	28	0	22.8	7.3	13.4	4.8	High tide crack pool, rock-rubble substrate
7	2	13	0	23	7.29	13.2	5.5	High tide pool, rock-rubble substrate
8	9	13	0	23.4	7.24	13.4	4.9	High tide pool, fissure depression, rock substrate
9	10	57	<6	22.1	7.46	14	6.9	Sunken depression two pool complex.
10	8	26	<2	22.3	7.45	13.8	4.8	Shaded cave pool, riparian *Sesuvium* northern edge
11	80	58	<15	22.3	7.56	13.2	7.4	97% *Batis* filled depression complex, 2 open pools, *Sesuvium* and *Cyperus*, biogenic sediments
12	15	78	<2	21.2	7.49	12.5	6.5	Collapsed lava tube pool
13	32	72	<4	22.3	7.58	13.6	7.5	Lava overhang, rocky depression, biogenic sediments
14	80	73	<6	23	7.5	14	6.2	70% *Batis* filled complex, 10 open pools, biogenic sediments
15	24	63	<4	22.4	7.52	14.1	7.9	90% *Batis* filled complex, 9 open pools, estuarine influence, biogenic/sand sediments
16	8	25	0	22.6	7.43	13.5	7.5	Dark fissure w/ *Hildenbrandia* epilithon
17	30	62	<10	23.6	7.27	13.7	7.8	Open cave pool, 40% *Cladophora* mat, Biogenic sediments
18	8	34	0	22.2	7.49	13.4	5.8	Rock fissure w/ no vegetation
19	64	75	<24	22.4	7.50	14.1	6.4	95% *Batis* filled depression with 5 open pools, biogenic sediments

4.2.1 Estuary Complex

The estuary at Kealakehe covers an area of approximately 1,120m^2. Its extent to the north includes the open water surrounding Makaopio heiau and the *Batis*-filled complex inland of the heiau. The eastern edge of the estuary is the inland extent of the mangroves. The southern extent runs along the mangrove and is bordered by thick *Batis* overlying rock and sand substrate. The estuary is a shallow water low-lying area with a series of open water pools and is surface connected to varying degrees during the higher high tide periods. Water chemistry and quality is influenced by direct connection to the ocean during medium and high tides mixed with the surface layer of fresher groundwater. Salinity ranged from 29.2 seaward to 14.7, the furthest inland open water exposure. Temperatures ranged from 27.5 to 22.5, and pH from 7.88 to 7.32.
The estuary is in an advanced stage of senescence, filled with *B. maritima* and *R. mangle.* The high density of this riparian and emergent vegetation, provide a barrier to more complete uniform mixing and movement of water and fauna. Sediments are comprised of sand and organic matter and vary in depth from 0cm-22cm. The estuary is distinguished from the anchialine pools not only by similar water characteristics, but similar biological components.

Many of the native species found in the estuary are common to tidepool and nearshore environments such as *Abudefduf abdominalis, Abudefduf sordidus, Sargocentron sp., Acanthurus triostegus,* and *Kuhlia sandvisensis.* Two fish species found at the furthest inland section were *Gymnothorax undulatus* and *Neomyxus leuciscus,* or possibly the introduced mullet *Chelon engeli.* There was an abundance of *T. cariosus* and Grapsid crabs. Unfortunately, throughout the estuary, minnows and tilapia were the dominant species with high population levels.

4.3 Conclusion and Evaluation

A majority of the anchialine pools at Kealakehe are degraded biologically and physically, primarily due the effects of introduced fish and plant species. The 7 pools that are currently devoid of alien fish face a high level of threat due to the proximity of pools that have these fish species. In addition, the pools with intact native biology have relatively low species abundance and diversity compared with other pools in the region and relatively small surface area and volume. They comprised only 10% of the total anchialine pool resource at Kealakehe, and approximately 40% of these were pools visible only at high tide. The high tide pools 6, 7, and 8 are the three to be eliminated by the proposed harbor.

Within the 19 pools, native and non-native fauna included 14 species comprised of 5 fish, 2 mollusca, and 6 crustacea. Algae within the pools primarily consisted of a mixed assemblage of diatoms and cyanobacteria, with several pools dominated by matted filamentous *Cladophora*, sp. The darker cave/overhang pools and high tide pools had epilithic *Hildenbrandia* sp. covering the rock substrate. Riparian vegetation was dominated by introduced species consisting of Pickleweed (*Batis maritima*), Mangrove

(*Rhyzophora mangle*), and Christmasberry (*Shinus terebenthifolius*). Only two species of native plants Akulikuli (*Sesuvium portulacastrum*) and Makaloa (*Cyperus laevigatus*) existed near the pools and comprised only few small patches and a single tuft (respectively).

Fortunately, most of the hypogeal anchialine shrimp have adapted to the presence of minnows by foraging in the pools at night. During daylight hours, only the adult shrimp appear to coexist at low population levels with the smaller *P. reticulata*, but the larger *G. affinis* and *Oreochromis* prevent the daytime appearance of hypogeal shrimp due to predation. The average salinity in Kealakehe pools is relatively high at 13.5 ppt compared to most other pools along the West Hawaii coastline, having an average of approximately 7 ppt. This high salinity appears to be characteristic of this region, and is similar to the average of most pools within the adjacent ahupua'a of Honokohau and Kaloko. This relatively high salinity is the likely reason aquatic insects were not found in any pools at Kealakehe. Though the rare damselfly *Megalagrion xanthomelas* has been observed and collected from Kaloko, a statewide assessment of its range has not found it to occur in water with salinity greater than 3ppt. However, there has been an unsubstantiated occurrence of the nymph in a pool of up to 8ppt (Polhemus, 1995). Another species of concern is the hypogeal decapod shrimp *Metabetaeus lohena.* These shrimp are sometimes predatory on *H. rubra* but are more often opportunistic omnivores similar to *H. rubra.* Predusk and nocturnal sampling at high tide is clearly the optimal method to determine habitat range and population densities for this species. These shrimp were found in 13 of the 19 pools, 7 of which had *M. lohena* only at night. The occurrences of H. *rubra* were found in 16 of 19 sampled pools, 8 of which had Opaeula observed only at night. Consequently, despite having numerous degraded anchialine resources at Kealakehe, there are opportunities for many of the pools to be restored and enhanced to a level where large populations of anchialine shrimp and other native species may return to inhabit the pools as they likely have in the past.

5.0 Framework for Management Program

In order to devise an anchialine pool management program, a set of objectives must be defined. In addition, a monitoring and evaluation program should be in place to detect changes in the physical, chemical, and biological components of the environment, and if necessary, modify the management program to achieve the stated objectives. The proposed list of management objectives and strategies for Kealakehe incorporates those suggested and actively in place by scientists and managers of anchialine systems in Hawaii, some of which include: recommendations by Maciolek in 1987 in an evaluation of anchialine pools at Awake'e, Kohanaiki, and Makalawena; recommendations by Chai, 1988 and 1990 for Ahihi-Kinau, Maui, and 3 National Parks with anchialine resources on Hawaii Island ; management of pools by Chai at Hualalai and Kona Village Resort, 1993-present; management plans developed by Brock for Waikoloa and implemented in 1987, and for Kukio Resort, implemented in 2000; and finally, those proposed by Brock and Kam in their 1997 CNPRSU technical report #112 for Kaloko-Honokohau National Historical Park. Additionally, these objectives and strategies should be taken as a preliminary framework or first step, not a static plan. Numerous valid interests toward the health and benefit of the anchialine pools and broader coastal ecosystem must be taken into account as the final objectives and strategies are formulated.

5.1 Management Objectives

Objective 1	To preserve, maintain, and foster the long-term health and native ecological integrity of anchialine pools at Kealakehe.
Objective 2	To protect and promote cultural practices and traditions surrounding anchialine resources at Kealakehe.
Objective 3	To provide education, interpretation, and interactive opportunities for the community to learn about and appreciate the anchialine resources.
Objective 4	To acquire a pond manager to implement the program, conduct monitoring, research, and reporting, and provide education to the community about anchialine and estuarine resources.

5.1.1 Objective 1 To preserve, maintain, and foster the long-term health and native ecological integrity of anchialine pools at Kealakehe.

To achieve this and allow all the other objectives a path toward success, the central component of the management program must involve the restoration and enhancement of the existing degraded pools. The existence of anchialine pools is ephemeral, and the senescence process that leads toward their ecological degradation and in filling, is dramatically accelerated due to the presence of alien species in and around the pools. The first stage of restoration will involve the removal of alien fish and plant species, and the removal of sediments from the pools and estuary. The consequence of this will be the natural return of native aquatic fauna to the pools very quickly. They are essentially "waiting in the wings" to reemerge from the subterranean habitat. The second stage will be the reintroduction of native plant species that formerly inhabited the pools and pool complexes. Again, as with the fauna, many native species will reemerge in the absence of

invasive plants, but some natives will need to be reintroduced to more quickly dominate the riparian and emergent habitat. Concurrent with the restoration should be a defined maintenance program to protect the ecological integrity of the system.

5.1.2 Objective 2 To protect and promote cultural practices and traditions surrounding anchialine resources at Kealakehe.

Concurrent with the ecological restoration should be the repair or reconstruction of the cultural features that were associated with the pools and estuary. Evidence suggests that early Hawaiian inhabitants used these pools. The pool management plan should incorporate some form of traditional use and management based on the testimony of lineal descendents of the ahupua'a if possible, or at least descendents from this region. The use of anchialine resources obtained from healthy native ecosystems can be accomplished on a sustainable basis without adverse impacts to the system. Hawaiians of the past considered anchialine pools a significant asset, a gift, and they were carefully maintained. This same respect and stewardship should be encouraged for pools at Kealakehe.

5.1.3 Objective 3 To provide education, interpretation, and interactive opportunities for the community to learn about and appreciate the anchialine resources.

Anchialine pools as an educational resource is important for many reasons. The pools are rare, accessible, and fascinating, allowing educators a unique opportunity to solidify concepts of science, math, and culture through their study. The pools allow people to learn about, experience, and appreciate a rare and unique habitat up-close. Understanding and appreciation of anchialine ecosystems lead to respect, and help foster the ideals and actions toward preservation and stewardship of the resource for many generations to come. Interpretive signs, tours and activities should be designed with this concept in mind.

5.1.4 Objective 4 To acquire a pond manager to implement the program, conduct monitoring, research, and reporting, and provide education to the community about anchialine and estuarine resources.

The designated anchialine pool manager should be well qualified and responsible for implementing the anchialine resource management program. This person will plan and oversee all the activities needed to fulfill the objectives. The manager will coordinate all aspects of the monitoring program and evaluate the results. As an ambassador to the public for the natural resources of Kealakehe, the manager must embrace the concepts and values of malama and pono in their management approach.

6.0 Water Quality and Aquatic Life Monitoring Plan

Environmental monitoring is vital as an early warning system to detect potential environmental degradation. A series of quantitative baseline analysis of the physio-chemical and biological components within the project site will provide a standard by which the effects of the development, anthropogenic activities, and natural phenomena on the environment can be measured. Changes in groundwater quality may or may not impact biological communities in the anchialine and estuarine environment. In either case, it is important to understand these relationships to effectively manage the resource. If there is significant deviation from the baseline especially in regard to nutrients, pathogens, and toxins, a mitigation plan to determine the cause and take decisive appropriate action should be implemented.

Water chemistry and sediment analysis should be undertaken in accordance with recommendations for groundwater and anchialine pool monitoring by the West Hawaii Coastal Monitoring Task Force, 1992. The monitoring protocol established in this document provides a complete and valuable management tool in helping to protect groundwater, anchialine, and marine resources. In conjunction with physio-chemical monitoring would be a quantitative analysis of biological communities. Determination of abundance, distribution, diversity, and physiological health of the populations should be key elements to the biological monitoring plan.

6.1 Monitoring Frequency

Using the 1992 monitoring protocol guidelines the monitoring program should be undertaken during 3 phases of the Kona Kai Ola project; 1) pre-construction to establish a comprehensive baseline analysis, 2) during construction as a continuation of monitoring protocol established during baseline analysis, and 3) post construction, or during the operations phase of the project. All monitoring should take place at least quarterly for water chemistry/quality and for biological communities as long as construction and pool restoration efforts are taking place. Thereafter, semi-annual monitoring should be adequate up to at least 5 years following construction activities. Extreme storm or other natural or anthropogenic events should also trigger a sampling analysis. Sediment sampling should be undertaken yearly if there is no indication of contamination by toxic pollutants. If contamination is discovered, monitoring should continue on a quarterly basis until there is no indication of contamination.

7.0 Mitigation Plan Recommendations

Based on the scale and scope of the proposed project, it is inevitable that there will be impacts to the anchialine pools, estuary, and marine environment. Managers of the proposed project have an opportunity to learn from, formulate plans, and make decisions based in some part on the mistakes and successes of other developments and resource management projects along the coast of West Hawaii. Much of the success in avoiding or mitigating detrimental environmental impacts will depend on the cooperation of the developer, landowners, and experts or persons knowledgeable in the field of environmental systems related to the project site. The following mitigation recommendations are a first step and a guideline for discussion and planning. The precise details of the plan and timeline will need to be determined at a later date.

7.1 Creation of New Anchialine Pools

A problem with the plan to restore existing degraded anchialine pools at Kealakehe is the proximity and high level of connectivity of some pools to the estuary. This connectivity will not permit the use of piscicides to eliminate alien fish, due to the possibility of harming marine organisms. Therefore, they cannot be restored to their former natural state dominated by native species. Additionally, the planned harbor is expected to eliminate three high tide anchialine pools that contain *H. rubra* and *M. lohena.* As a response to this loss of habitat there is significant opportunity to create new anchialine pools and greatly expand the native habitat and resource. It has been demonstrated at several projects in West Hawaii that anchialine pools can be created and will be colonized with a full compliment of anchialine species endemic to the area (Brock and Norris, 1988, Chai pers. observation). Anchialine pools are considered focal points of higher productivity relative to the subterranean groundwater habitat around them. Their productivity promotes an increase in population levels of anchialine species within the pools themselves and throughout the subterranean habitat surrounding them. In regard to decapod crustaceans, there exists a positive linear relationship between the size of the anchialine pool and the population of shrimp that inhabit them. A reconnaissance of the area indicates numerous potential sites within the project area to create anchialine pools wherever the land surface is within a few meters from the water table. In addition to increasing habitat productivity for native fauna, anchialine pools are functionally wetlands and have the ability to sequester and convert dissolved organic nutrients and other pollutants from the groundwater before they enter the marine environment (Brock and Kam, 1997, Ogden and Campbell, 1999).

7.2 Water Resources Protection and Mitigation

7.2.1 Bioretention

There is a high probability that nutrients and other potential pollutants will runoff landscaping and impermeable surfaces such as roadways and parking lots during medium or high rainfall events. Some of these pollutants will enter the groundwater table and into anchialine pools and ultimately the ocean. As an alternative to directing runoff into the ground through drywells, storm water should be directed into bioretention areas such as constructed surface or subsurface wetlands, vegetated filter strips, grass swales, and planted buffer areas. Storm water held and moved through these living filter systems are essentially stripped of most potential pollutants, and allowed to slowly infiltrate back to the groundwater table (Innovative Technologies for Storm water and Wastewater Workshop, 2005). Bioretention is a BMP (Best Management Practice) that would be a highly appropriate application for the proposed development. Furthermore, BMPs utilized in series may incorporate several storm water treatment mechanisms in a sequence to enhance the treatment of runoff. By combining structural and/or nonstructural treatment methods in series rather than singularly, raises the level and reliability of pollutant removal. Another means to reduce the potential for groundwater contamination is to increase soil depth above the standard in landscaped areas. This will allow chemicals to be held in the soils longer for more complete plant uptake and breakdown of these chemicals by soil microbes. A specific guide for chemical application by landscape maintenance personnel will be a beneficial tool to help avoid contamination of groundwater resources.

7.2.2 Salinity Adjustment

In the 2006 assessment by Ziemann regarding the impact to the southern pools from the proposed construction of the harbor, he stated that this construction would cause the salinity in the anchialine pools to become equivalent to the ocean at 35ppt. The anchialine biology would then soon perish. There is currently a level of uncertainty by professional hydrologists as to the exact movement of surface groundwater and a final determination of anchialine salinity following the harbor construction. The dynamics of groundwater movement through a porous lava medium both seaward and laterally along the coastline is an inexact science. This is compounded by the variations in water density, including stratification of salinity within the proposed harbor and capillary movement of low-density surface water through the substrata. The assessment that all anchialine pools will be barren with the construction of the harbor may be premature. *H. rubra* are routinely drawn from high salinity wells at 30 – 32 ppt and survive in this salinity for years. As mentioned early in this document, high populations of *H. rubra* and *M. lohena* have thrived and reproduced in pool salinities of 27ppt. If the pools do become full strength seawater at 35ppt, there exists uncertainty on the long-term effects to anchialine organisms, since there are no long-term studies or examples of native anchialine ecosystems at 35ppt. Native anchialine pool vegetation also has relatively high salinity tolerance. Akulikuli will grow as a riparian plant and *R. maritime* will thrive as an aquatic plant at a salinity of 27ppt. *Bacopa monieri* and Makaloa will grow in salinities of up to

20ppt. Other than Aki aki, (*Sporobolis virginicus*), and Ohelo kai (*Lycium sandwicense*) no other native aquatic or riparian flora will likely thrive among seawater pools.

If the salinity were expected to rise to 35 ppt, a possible mitigation would be to surcharge man-made anchialine pools created adjacent to or in the vicinity of natural pools with low salinity well water. If sufficient volume is used, it is theoretically possible to lower salinity in adjacent natural anchialine pools. This surcharge method has been successfully used to raise salinity in anchialine pools and cause the salinity rise in adjacent pools of at least up to 10 meters away. Surcharging with low salinity should work as well or better since the lower density water will essentially float atop the higher salinity water at the surface layer, and move throughout the complex of natural pools. Surcharging may also be a viable mitigation to dilute and more rapidly disperse any pollutants that may be detected in the pools.

If the harbor is to be a receptacle for the discharge of seawater from a man-made lagoon, it may help to maintain lower salinity in pools if the discharge of this seawater is place at the bottom of the harbor, thereby preserving the stratified layer of lower density surface water within the harbor. If the porosity of the lava near the surface of the groundwater table is sufficient, it may allow this low salinity surface water to move laterally through the area of anchialine pools.

7.2.3 Groundwater and Anchialine Pool Contamination Response

The response plan to contamination of the groundwater should be designed to prevent the negative impact to aquatic communities and human public who use the pools. Mitigation should focus on halting and reversing the source of contamination and its effects on living communities. Environmental problems that will trigger notification of the Developer and appropriate agencies, and require immediate mitigation and corrective action to halt the source of contamination, include: 1) the finding of pesticides or other toxic pollutants within the groundwater, anchialine pools or pool sediments; 2) a significant deviation in dissolved nutrients above normal baseline parameters; 3) a significant decline in population or a serious wide-spread health problem in the biological components that comprise the anchialine or estuarine habitat.

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Attachment 8

The increased level of fisheries knowledge has spawned an atmosphere of stewardship in the general charter-boat fishing community. With catch and release programs returning upwards of 40 percent of the Kona catch back to the ocean there is an obvious awareness that the value of catching the fish is often far greater than the value of selling it. It is ~~recommended~~ proposed that facilities and programs to foster continued stewardship, fisheries science, tracking of all fish catch, and educational programs be implemented in the design of the new marina facilities.

The proposed marina, marina support facilities, public marina promenade, fishing club, and marine science center will provide a venue for implementing the following efforts:

- Efforts to promote tag and release will be fostered through public education and the implementation of more "Catch and Release – Only" tournaments.
- Promote management through catch limits to possibly include slot weight catch limits, ~~ie.~~i.e. must tag & release animals between 250–950 pounds
- Promote various other stewardship measures relating to fisheries conservation.

~~3.9.5~~3.9.4 Marine Mammals and Sea Turtles

In addition to water quality, which is discussed in Section 3.9.1.3, other environmental impacts that may affect marine mammals and sea turtles include noise and vessel collisions. The following sections describe existing conditions, potential impacts and suggested mitigations to prevent negative impacts to marine mammals and sea turtles from noise and vessel collisions.

~~3.9.5.1~~3.9.4.1 ~~Existing Conditions~~Affected Environment

A number of marine mammal and turtle species are found in Hawaiian waters near the Kona Kai Ola project site. Detailed information on the abundance, behavior, threats to the species, hearing ability and vocalization data is provided for all species in Appendix S. Data on the most prevalent endangered species and species of particular interest are summarized here.

Humpback Whales: The population of h~~H~~umpback whales (*Megaptera novaeangliae*) around Hawaiʻi was estimated to be between ~~are mammals and belong to the baleen whale suborder, *mysticeti*. An estimated~~ 4,500-6,500 in 2000 ~~whales migrate between subpolar Alaska and Hawaiʻi each year~~ (Mobley et al 2001). The population growth rate between 1993 and 2000 is estimated to be seven percent indicating that the population is recovering from its dramatic reduction due to commercial whaling. It is worth noting that this is considered a high rate of increase for a mammalian species.

The highest densities of animals are found within the 100 fathom isobath. ~~and seek refuge in shallow waters close to shore.~~ Most humpbacks off Hawaiʻi are found north of Honokōhau in the waters of the Hawaiian Islands Humpback Whale National Marine Sanctuary. Nevertheless, they are commonly seen off Honokōhau in winter months. Humpbacks are not deep diving animals. Whales in Hawaiʻi typically dive to less than 100 feet, although occasional deeper dives are possible (Hamilton et al. 1997)The whales breed and give birth while in Hawaiʻi during the winter months, and migrate north to feed each spring.

~~Humpback whales found in Hawai‘i’s waters are part of a global population of Humpback whales that was reduced by over 250,000 individuals, or 90 percent, due to hunting (Johnson et al 1984). In 1966, the International Whaling Commission instituted a moratorium on all hunting of whales globally, and populations have begun to rebound. The North Pacific population of humpback whales, with a population of approximately 15,000 prior to hunting, is recovering from an estimated low of 1,000 individuals (Rice 1978, Johnson et al 1984). Humpback whales are also protected under the Federal Endangered Species Act. It is estimated that Hawai‘i’s population of Humpback whales is growing by 7% annually (Mobley et al 2001).~~

Congress designated the Hawaiian Islands Humpback Whale National Marine Sanctuary (HINMS) on November 4, 1992, and was followed by the Governor of Hawai‘i’s formal approval in 1997. The Sanctuary’s purpose includes protecting humpback whales and their habitat within the Sanctuary, educating the public about the relationship of humpback whales to the Hawaiian Islands marine environment, managing the human uses of the Sanctuary, and providing for the identification of marine resources and ecosystems of national significance for possible inclusion in the Sanctuary. The sanctuary is approximately four nautical miles north of Honokōhau Harbor.

~~While waters surrounding the main Hawaiian islands constitute one of the world’s most important North Pacific humpback whale habitats (Calambokidis et al. 1997), the Sanctuary actually encompasses five noncontiguous marine protected areas across the Main Hawaiian Islands, totaling 1370 square miles. Almost half of this area surrounds the islands of Maui, Lāna‘i and Moloka‘i. Smaller areas are designated on the North shore of Kaua‘i, North and Southeast shores of O‘ahu, and Hawai‘i’s Kona Coast. On Hawai‘i’s Kona Coast, the Sanctuary encompasses the entire northwest-facing coast, consisting of submerged lands and waters seaward of the shoreline to the 100-fathom (183 meter) isobath from ‘Upolu Point southward to Keāhole Point, which is approximately four nautical miles north of Honokōhau Harbor.~~

Whales have very sensitive hearing, so any loud underwater sound has ~~may have~~ the potential to disturb these animals. ~~Vessel collisions are also a concern with whales.~~ Playback experiments have estimated that humpback whales will respond to biologically meaningful sound at levels as low as 102 dB re 1 µPa, a level that is similar to background ambient noise (Frankel et al. 1995). Increases in vessel numbers will lead to an increase in noise from operating boats. However, even at its greatest predicted increase, the median sound level from active boats is not expected to raise sound levels to an intensity that would be considered an impact (Level B take) to marine mammal population (See Appendices T-2 and T-3). Humpback whale song ranges from 20 Hz to over 10,000 Hz, with most acoustic energy typically concentrated in the 100-1000 Hz range. This vocal production and the anatomy of their inner ear indicate that these animals are most sensitive to low-frequency sound (Ketten 1992).

Numerous studies have shown that human activity can affect humpback whale behavior, including vessel activity (Bauer 1986; Norris 1994; Corkeron 1995; McCauley et al. 1996; Scheidat et al. 2004), oceanographic research (Frankel and Clark 2000; Frankel and Clark 2002), and sonar (Miller et al. 2000; Fristrup et al. 2003). If the humpback whale population continues to expand at its present rate (8%/year) it can be expected that greater numbers of whales will extend into waters off the Kona Coast. This is likely to increase the demand for whale watching vessels from the new harbor and this increase will have a negative impact on the whale population expansion. The increase in both the number of vessels and number of whales increases the chance for collisions.

Vessel collisions are also a major concern. The majority of whale strikes occur~~red~~ where whales and boats are most common, such as in ~~and boats watching are common as in~~ shallow waters between Lāna‘i and Maui. In a recent study, three of ~~conducted by NMFS on~~ 22 ~~27~~ recorded whale-vessel collisions ~~strikes~~ in the main Hawaiian Islands ~~, only two were recorded~~ occurred off the Kona coast. (Lammers et al. 2003). That study also found that 14 of the 22 collisions were reported between 1995 and 2003. This observed increase may result from more awareness of the issue, or from the greater number of both whales and vessels in Hawaiian waters. In Hawai‘i, data from 1972 to 1996 reveal at least six entanglements of humpback whales in commercial fishing equipment (Mazzuca et al. 1998). These data also indicate an increasing trend of entanglement since 1992 and a three-fold increase in death and entanglement occurrences related to human activity in 1996.

It is highly unlikely that humpback whales will approach to within the Level A or Level B impact “take” zones created by the explosive blasts of harbor construction. However, the sounds generated by these explosions will be within the frequency hearing range of humpback whales and could potentially be heard by whales between Kona and Maui. Modeling predicts that the maximum sound level two miles offshore the site is less than 150 dB re1 μPa, which is less than the threshold for Level B impacts. As the explosions are planned to occur daily for up to 9 months, the cumulative impact of this noise must be considered if construction is anticipated when whales are expected in the area (December 15 – March 30).~~In one instance, a fishing boat was pulling in a catch and was lifted by a whale. In the other instance, a whale was struck by a dive boat heading towards its diving spot.~~

Dolphins: A number of dolphin species are found in the waters near Honokōhau Harbor. Detailed information on all of these can be found in Appendix S. Spinner dolphins (*Stenella longirostris*) are regularly seen in shallow water and in close proximity to the project site. ~~Spinner dolphins (*Stenella longirostris*), often inhabit waters within Honokōhau Bay and at times intentionally congregate near the harbor channel to take advantage by bow-riding outgoing vessels. "Spinners" common name stems from their habit of leaping clear of the water and twirling in the air.~~ They are the smallest dolphins typically seen in Hawai‘i, with a mature size of 6 feet in length and 160 pounds.

Spinners school in pods of a few animals to ~~100~~ 180 or more, with pod sizes of 1-20 being most common (Östman-Lind et al. 2004). They ~~and show community behavior when~~ feed~~ing in~~ on mesopelagic fish, squid and shrimp in deep water at night, and rest in nearshore shallow waters during the day (Norris and Dohl 1980; Benoit-Bird et al. 2001). ~~when they come near shore to play and rest. On the Island of Hawai‘i, Kealakekua Bay is one location of almost daily spinner visits, but they frequent many other bays along the coast and regularly rest in Honokōhau Bay.~~ There are seven primary resting areas along the Kona coast of Hawai‘i, including Honokōhau Bay, where spinners are regularly seen near the harbor entrance (Östman-Lind et al. 2004). There is some evidence that the spinner dolphins may be resident to the area (Östman-Lind et al. 2004), making them more susceptible to repeated disturbance.

The hearing ability of spinner dolphins has not been measured. However, hearing of the related striped dolphin (*Stenella coeruleoalba*) was measured between 500 Hz and 160 kHz, with maximum sensitivity at 64 kHz (Kastelein et al. 2003). The hearing response of this single dolphin was less sensitive below 32 kHz than other dolphins. ~~As all marine mammals have very sensitive hearing, any loud underwater sounds have the potential to disturb dolphins as well. Given the sporting habit of spinners and other dolphins of bow-riding ships and small boat wakes, they are apparently not overtly impacted by vessel traffic noises.~~

Despite their limited sensitivity to low frequency sound, spinner dolphins have been shown to be impacted by human activity. Examples include interruption of resting activity and increases in the number of higher energy behaviors (Luna-Valiente and Bazúa-Durán 2006). Numerous studies describe changes in distribution (Haviland-Howell et al. in press) and short-term behavioral changes of dolphins in response to vessel traffic (Bejder et al. 1999; Scarpaci et al. 2000; Gregory and Rowden 2001; Nowacek et al. 2001; Van Parijs and Corkeron 2001; Ritter 2002; Lusseau 2003; Ng and Leung 2003). However, it has been established that for at least one population of bottlenose dolphins, these repeated short-term effects translate into long-term detrimental effects on the affected population (Bejder et al. 2006a; Bejder et al. 2006b).

In Hawai‘i, some entanglements of spinner dolphins have been observed (Nitta and Henderson 1993; Rickards et al. 2001) but no estimate of annual human-caused mortality and serious injury is available. A habitat issue of increasing concern is the potential effect of swim-with-dolphin programs and other tourism activities focused on spinner dolphins around the main Hawaiian Islands (Östman-Lind et al. 2004).

Hawaiian Monk Seals: Endangered Hawaiian Monk Seals (*Monachus schauinslandi*, Hawaiian Name: ‘Ilio holo I ka uaua) ~~are on the endangered species list~~. ~~They~~ are rare, but not unknown along the Kona Coast. ~~Fortunately, monk seals are air breathing and spend the majority of their time above water where they are easily observed. If a monk seal is reported observed in the area, Kona Kai Ola would work with relevant agencies to protect the seal.~~ Most monk seals are found in the Northwest Hawaiian Islands, but recent aerial surveys estimated that there are 52 seals in the main Hawaiian Islands (Baker and Johanos 2004). There have been 13 sightings between 2003 and 2006 in the vicinity of Kaloko-Honokōhau National Historical Park (NOAA protected species division data) indicating regular, albeit low-level use of these areas by monk seals. ~~One~~Two birth on the Island of Hawai‘i have~~s~~ been reported (Baker and Johanos 2004).

The best population estimates for Hawaiian monk seals (as of 2003) was 1,244 (Carretta et al. 2004). However the population is currently showing a decline that has been continuing since the 1950s (Antonelis et al. 2006).

Underwater hearing in the Hawaiian monk seal has been measured between 300 Hz to 40 kHz. Their most sensitive hearing is at 12 to 28 kHz, which is a narrower range compared to other phocids. Above 30 kHz, their hearing sensitivity drops markedly (Thomas et al. 1990).

Monk seals are very intolerant of human activity and are easily disturbed. When the U.S. military inhabited Sand Island and the Midway Islands and Kure Atoll, the monk seals disappeared until after the military left. Monk seals prefer to be solitary animals (Reeves et al., 2002).

Sea Turtles: Five species of sea turtles are known to frequent Hawaiian waters, with Hawaiian green sea turtles (*Chelonia mydas*) by far the most abundant at 97% of the total numbers, hawksbill turtles (*Eretmochelys imbricata*, 1.7% of total), olive ridley turtles (*Lepidochelys olivacea*, 0.8%), and occasional sightings of leatherback (*Dermochelys coriacea*) and loggerhead sea turtles (*Caretta caretta*, Chaloupka, et al, 2006, from stranding reports). Green sea turtles are the most plentiful large marine herbivore in the world and have experienced a very successful population recovery in Hawaiian waters since 1974 when harvest was outlawed in Hawai‘~~iH~~i, and 1978 when they became protected under the Endangered Species Act (Balazs, et al. 2004). Both green sea turtles and hawksbills are known to breed and nest on beaches within the main Hawaiian Islands, and have a 25-30 year generation time with a life span of 60-70 years (Balazs et al 2004). Total population numbers of green sea turtles in the Hawaiian archipelago have not been estimated, but the population has at least tripled since the 1970s and may now be approaching the carrying capacity of the islands (Chaloupka, et al. 2006).

Bartol et al. (1999) measured the hearing of juvenile loggerhead sea turtles using auditory evoked potentials to low-frequency tone bursts found the range of hearing to be from at least 250 to 750 Hz. The frequency range that was presented to the turtles was from 250 Hz to 1000 Hz (Bartol et al. 1999).

Most recently, Bartol and Ketten (2006) used auditory evoked potentials to determine the hearing capabilities of subadult green sea turtles and juvenile Kemp’s ridleys. Subadult Hawaiian green sea turtles detected frequencies between 100 and 500 Hz, with their most sensitive hearing between 200 and 400 Hz. However, two juvenile green turtles tested in Maryland had a slightly expanded range of hearing when compared to the subadult greens tested in Hawai‘i. These juveniles responded to sounds ranging from 100 to 800 Hz, with their most sensitive hearing range from 600 to 700 Hz. The two juvenile Kemp’s ridleys had a more restricted range (100 to 500 Hz) with their most sensitive hearing falling between 100 and 200 Hz (Bartol and Ketten 2006).

Adult ~~G~~green turtles are primarily herbivorous often seen on reefs as deep as 100+ feet but much more common in shallower waters. Foraging behavior of green turtles is well documented and in Hawai‘i is typically characterized by numerous short dives (4 to 8 min) in shallow water (typically less than 3 m) with short surface intervals (less than 5 sec) (Rice et al. 1999).Resting periods are characterized by longer dives (over 20 min) in deeper water (4 to 40 m) with surface intervals averaging 2.8 min (Rice et al. 1999). The amount of time that turtles spend foraging versus resting is still largely unknown. Green turtles in Hawai‘i frequently use small caves and crevices in the sides of reefs as resting areas, and spend significant amounts of time on the tops of reefs (Balazs et al. 1987). Green turtles are known to be resident in Kiholo Bay, Hawai‘i (Balazs et al. 2000), and presumably other areas as well, potentially increasing their susceptibility to vessel collision and/or repeated disturbance. Two turtle “cleaning stations” have been reported near the mouth of Honokōhau Harbor. ~~During periods of calm water green sea turtles are often seen over very shallow reef flats where the choicest of algae are to be found. While some turtles may "rest" upon the surface, it is much more common to find them in small caves or wedged between coral heads where they are less subject to shark attacks. Green sea turtles may occasionally be seen far at sea (they nest in French Frigate Shoals in the NW Hawaiian Islands), but they are much more prevalent over the shallow shoreline areas where they forage for food.~~

Vessel collisions and potential noise impacts are a concern with regard to turtles. In a study of 3,861 turtle strandings in the main Hawaiian Islands from 1982 – 2003 (Chaloupka, et al. 2006), boat strikes accounted for only about 2.7 percent of the cases and were almost always fatal (95 percent). Entanglement in gill nets accounted for about six percent of strandings and also had a high rate of mortality (75 perce~~d~~nt). Hook and line entanglement (seven percent of strandings) was much less likely to result in the death of the turtle (52 percent mortality). At least 20 green sea turtles have stranded in Honokōhau Harbor or along the boundaries of Kaloko- Honokōhau National Historical Park. ~~Of all 3,861 strandings recorded in the Main Hawaiian Islands since 1982 only three occurred within 10 miles north or south of Honokōhau Harbor (Balazs, personal communication from NMFS database).~~

Recent increases in longline fisheries may be a serious source of mortality. Greens comprised 14% of the annual observed take of all species of turtles by the Hawai‘i-based longline fishery between 1990 to 1994 (NMFS 1998a). Over the period of 1994 to 1999, it was estimated that an annual average of 40 green sea turtles were caught by the Hawai‘i-based longline fishery (McCracken 2000).

Recent proliferation of a tumorous disease known as fibropapillomatosis (Herbst 1994) may reverse improvements in the status of the Hawaiian stock (NMFS 1998a), although recent modeling suggests that population levels continue to increase despite the disease (Chaloupka and Balazs 2005). The disease is characterized by grayish tumors of various sizes, particularly in the axial regions of the flippers and around the eyes. This debilitating condition can be fatal and neither a cause nor a cure has been identified.

Hawksbill turtles (Eretmochelys imbricate) are observed less often than green sea turtles near Honokōhau. About 20-30 female hawksbills nest annually in the Main Hawaiian Islands (NMFS 1998b). In 20 years of netting and hand-capturing turtles at numerous nearshore sites in Hawai‘i, only eight hawksbills (all immatures) have been encountered at capture sites including Kiholo Bay and Ka‘u (Hawai‘i), Palo‘ou (Moloka‘i) and Makaha (O‘ahu) (NMFS 1998b). It was only recently discovered that hawksbills appear to be specialist sponge carnivores (Meylan 1988). Previously they had been classified as opportunistic feeders on a wide variety of marine invertebrates and algae.

Increasing human populations and the concurrent destruction of habitat are also a major concern for the Pacific hawksbill populations (NMFS 1998b). Hawksbill turtles appear to be rarely caught in pelagic fisheries (McCracken, 2000). However, incidental catches of hawksbill turtles in Hawai‘i do occur, primarily in nearshore gillnets (NMFS 1998b). The primary threats to hawksbills in Hawai‘i are increased human presence, beach erosion and nest predation (*e.g.*, by mongooses) (NMFS 1998b).

~~3.9.5.2~~3.9.4.2 Anticipated Impacts and ~~Recommended~~ Proposed Mitigation

A complete analysis of the in-air and in-water potential acoustic impacts from the construction of the Kona Kai Ola small boat harbor was completed by Marine Acoustics, Inc.(MAI) and is included in this document as Appendix T-3. In conducting this analysis, the best available scientific, environmental, geologic, and meteorological data were obtained and used to calculate the acoustic transmission loss (TL) and subsequently to predict the received levels (RLs) at the five receiver sites. State of the art acoustic propagation models were employed in this analysis to determine in-air and in-water TL. MAI used the Acoustic Integration Model© (AIM©) to assess the impact of the predicted acoustic sound field on the species of marine mammals that could conceivably occur near the Kona Kai Ola project site.

The conclusion of that report determined that the criteria for Level A impacts to marine mammals for either in-air or in-water conditions at the receiver sites were never exceeded for the model source and receiver locations for non-blasting activities. However, these thresholds could be exceeded by the explosive blasting used to create the new harbor. For both in-air or in-water acoustic propagation, this only occurred when an animal was within about 200 meters (656 ft) of the explosion, This condition could only occur when the explosive source was at locations farthest north in the new harbor and closest to the existing harbor. This condition mandates that a safety range out to at least 200 meters (656 ft) of the source be shown to be clear of all marine mammals and sea turtle prior to each blast to preclude potential Level A takes.

The MAI report indicated that the in-air RLs for the explosive sources would exceed the assumed 100 dBA threshold for Level B harassment of pinnipeds (seals) for ranges out to about 0.4 nm (i.e., 800 yds [731 m]). This threshold is nominally for pinnipeds, but it should be extended to surface resting marine mammals and basking or beached sea turtles. Therefore, an in-air safety buffer of at least 731m from any explosive source is proposed, that should be maintained and found clear of marine mammals and basking or beached sea turtles prior to any blasts. It should be noted that although a receiver site was not modeled specifically in the existing harbor, that area is often within the range of this safety buffer and that extra care should be taken to ensure that no marine mammals or sea turtle are in the existing harbor prior to any blast. Analysis of the most restrictive Level B in-water explosive threshold shows that it is only exceeded when an animal is closer than 300 m (984 ft) from the explosive source.

Although the possibility exists for Level B impacts to marine mammals, based purely on the sound fields produced by the explosive blasts, analysis is the marine mammal distribution and movement as predicted by the AIM model, indicates that this is very unlikely situation. Therefore, it is expected that there will be much less than 0.5 Level B takes, with or without mitigation. But the mitigation safety buffer must still be enforced to preclude the unlikely possibility of marine mammals or sea turtle being near the explosive sources when they are used.

It should be recognized that several mitigation measures are already built into the proposed project. For example, the proposed practice to maintain a rock "dam" separating the construction site from the existing harbor reduces acoustic energy propagating to area potentially containing marine mammals or sea turtles. Also, this dam precludes animals from entering the construction area. This dam or land-bridge will be in place for all drilling and dredging activities, except for the removal of the land bridge itself.

Several other possible methods of mitigation are available to the Kona Kai Ola project, and feasibility, practicality, and benefit will be discussed with the National Marine Fisheries Service (NMFS) during consultation, and may be implemented subsequent to that consultation. The first possible mitigation technique is to acoustically monitor the potentially impacted areas during construction to: a) assess the accuracy of the modeling and b) to interact proactively with construction personnel to ensure that the identified threshold levels are not exceeded. Although the best available science and data was used to model the acoustics of the area, numerous conservative assumptions needed to be built into the modeling. By monitoring the actual levels received, in-situ corrections/updates to modeled parameters could potentially reduce the built--in conservativeness and reduce the potentially impacted areas. For example, the modeling assumes that all of the small voids in the bedrock are water-filled and therefore impart minimum attenuation on the acoustic signal as it propagates through. If even a small percentage of the voids are gas-filled, this attenuation would increase greatly and the impacted area would be reduced.

Another possible mitigation technique would be to augment the land-based visual observer, who it is assumed would verify that the area was clear the animals, with boat-based observers. This would increase the effectiveness of recognizing the presence of marine mammals and sea turtles in the potentially affected areas.

Additionally, interactions with the construction teams to alter the blasting methods modeled could potentially mitigate and reduce acoustic impacts to marine animals. A blasting expert will be consulted to develop a discontinuous non-linear blasting plan that will optimize cancellation of the explosion pressure wave into the marine environment. Examples of possible changes include: reducing charge size, reducing the depth drilled and blasted during any blast, reducing the number of blast holes or the volume of each blast, etc. The combination of these techniques with acoustic monitoring could potentially allow a large portion of the northern third of the harbor to be excavated with little or no potential impact to marine animals.

Interactions with NMFS during the consultation period will be used to examine these or any other techniques which may be identified. Also, the project is requesting help in identifying any possible method known to NMFS to establish and maintain turtle exclusion areas, especially in the existing harbor, without harassing the turtles. It may become apparent during those consultations that even with the identified buffer zones and mitigation techniques that an Incidental Harassment Authorization (IHA) is required, especially for the northern third of the proposed harbor.

Marine Acoustics, Inc. also completed a study of the expected ambient noise levels in Honokōhau Bay as a result of the increased vessel traffic from the expanded harbor. This report is included in this document as Appendix T-2. That report concluded that the average maximum daytime ambient noise levels would be expected to increase about 9.7 dB across the frequency spectrum from 100 Hz – 2 kHz, with the quadrupling of the vessels using the expanded harbor (i.e., the proposed action). Although significant, this increase would occur primarily during daylight hours, and the predicted median ambient noise would still be below 100 dB for all frequencies. The other significant factor is that there will be a quadrupling of the number of localized (i.e., small) individual sound fields in the area. These sound fields surround the individual boat that are contributing to the overall ambient noise. Noise levels in excess of 120 dB extend out to about 550 m (1804 ft) from these boats, with even high levels at closer ranges. Short of actual collisions with animals, Level A impacts are unlikely for noise levels typically generated by small boats. The Level B threshold nominally extends to approximately ten meters around each boat (depending on equipment such as size of motor, conditions of propeller and other equipment). Therefore potential Level B impacts to marine mammals and sea turtles would only occur within this range. Therefore, the chance for potential Level B impacts is small.

Completion of the harbor expansion project will increase the vessel traffic crossing the Hawaiian Islands Humpback Whale National Marine Sanctuary, the southern boundary of which is approximately four nautical miles north of Honokōhau Harbor. At a time when the whale population is growing, an increase of vessel traffic may increase the likelihood of vessel-whale collisions. Related to vessel traffic, an increase in whale watching activities is also likely. Vessels participating in these activities directly seek out higher whale population densities, increasing the likelihood of collisions, but also having the potential for disrupting whale behaviors such as resting, courting, mating or birthing.

As noted earlier, however, of the ~~27~~ 22 recorded whale strikes in the main Hawaiian Islands, only ~~two~~ three were recorded off the Kona coast. Sanctuary managers may need to implement additional regulations for private and/or commercial activities directly involving whale encounters. Mariner education programs, already in place as part of Sanctuary operations, will help to mitigate possible impacts due to increased boaters, and the proposed marine science center will complement Sanctuary educational programs.

~~Impacts to turtles may occur during construction of the marina. Since most of the marina will be excavated in a land-locked condition, turtles will not be subject to any potential harm from excavation. Experience during construction of the Ko Olina lagoons, and the expansion of the Barber's Point Harbor on O'ahu indicate that turtles abandoned their offshore (30-100 ft depth) resting habitats and concentrated in very near shore waters adjacent to the harbor and, at times, even within the active construction areas as soon as blasting and excavation began. Although no turtle injuries or mortalities were reported during either of those harbor construction activities, this should serve as a cautionary example for future coastal construction activities.~~

An increased level of impacts to turtles from increased boating and fishing activities may occur. ~~The level of impact documented by National Marine Fisheries Service is limited to only three turtle mortalities confirmed, since 1982, from a total of 3,861 strandings throughout the Main Hawaiian Islands~~. Of the 3,861 turtle strandings recorded from the Main Hawaiian Islands since 1982, 75% were mortalities, and of these about 4% (~est. 116, from Figure 3 of Chaloupka, et.al.) were from boat strikes and 3 of these occurred within 10 miles of Honokōhau Harbor. Data from NPS staff at the adjacent Kaloko-Honokōhau National Historical Park show a total of 20 strandings within the parking (19) and harbor (1) between 2000 and 2006 with one attributed to boat strike and 6 to fishing gear entanglement. Eleven additional gear entanglements and one additional boat strike were also recorded but not listed as strandings. Human caused impacts from fishing and boat strikes are anticipated to increase as turtle populations continue to increase and boating /fishing activities increase with the expanding harbor.

~~It would appear that anthropomorphic impact to turtles from boat strikes and fishing activities is very low along the Kona Coast adjacent to the existing harbor. It is likely that this is due in part to the relatively steep ocean bottom that limits the habitat of the turtles to the very nearshore areas away from the areas of heavy boat traffic~~. Recognition by the general public that sea turtles are protected ~~also~~ puts a heavy social pressure on fishermen who may inadvertently catch a sea turtle, and is likely a factor in the recovery of this species. Although no adverse impacts to turtles have been documented within the existing harbor, the close proximity of boats and turtles in this environment is cause for concern.

~~During land-based construction of the marina, no mitigation is necessary as previous experience has shown that turtles are not adversely impacted by these activities.~~ Once the land bridge is open, ~~however,~~ it is highly likely that turtles will be attracted into the new harbor and be subject to potential harm from in-water construction of piers or other facilities. During this period of time and until the harbor is operational, ~~it is recommended that a~~ mesh barrier will be ~~is~~ erected across the new harbor channel to exclude turtles from the inner basin. The mesh size needs to be selected in consultation with ~~regulatory~~ NMFS ~~agencies~~ to make sure it does not entangle turtles.

As the new harbor area will ~~likely~~possibly attract turtles to the basin (similar to the existing harbor) and an increase in boat traffic is expected in the harbor channel there will be an increased possibility of turtle strikes within the channel and new harbor area. To minimize this possibility it is ~~recommended~~ proposed that educational signs be erected around the harbor describing the turtles and warning boaters to be cautious while traversing harbor channels. The slow no-wake lane in the entrance channel should also be strictly enforced and the State should consider extending the slow no-wake zone further out to the first green buoy.

~~As all marine mammals have very sensitive hearing, any loud underwater sounds have the potential to disturb these creatures. Potential underwater acoustics may impact marine mammals and sea turtles during construction activities, such as blasting and pile driving. Appendix Q contains a study of underwater noise impacts during the construction and operation of the proposed project.~~

~~To mitigate impacts related to noise generated by construction activities, such as blasting and pile driving, a program to monitor sound levels and the presence of marine mammals and sea turtles will be implemented. Construction activities will be adjusted if whales, monk seals, dolphins or sea turtles are in the vicinity. Further, keeping the land bridge closed to the ocean until all major pile driving and blasting are completed will further avoid adverse impacts.~~

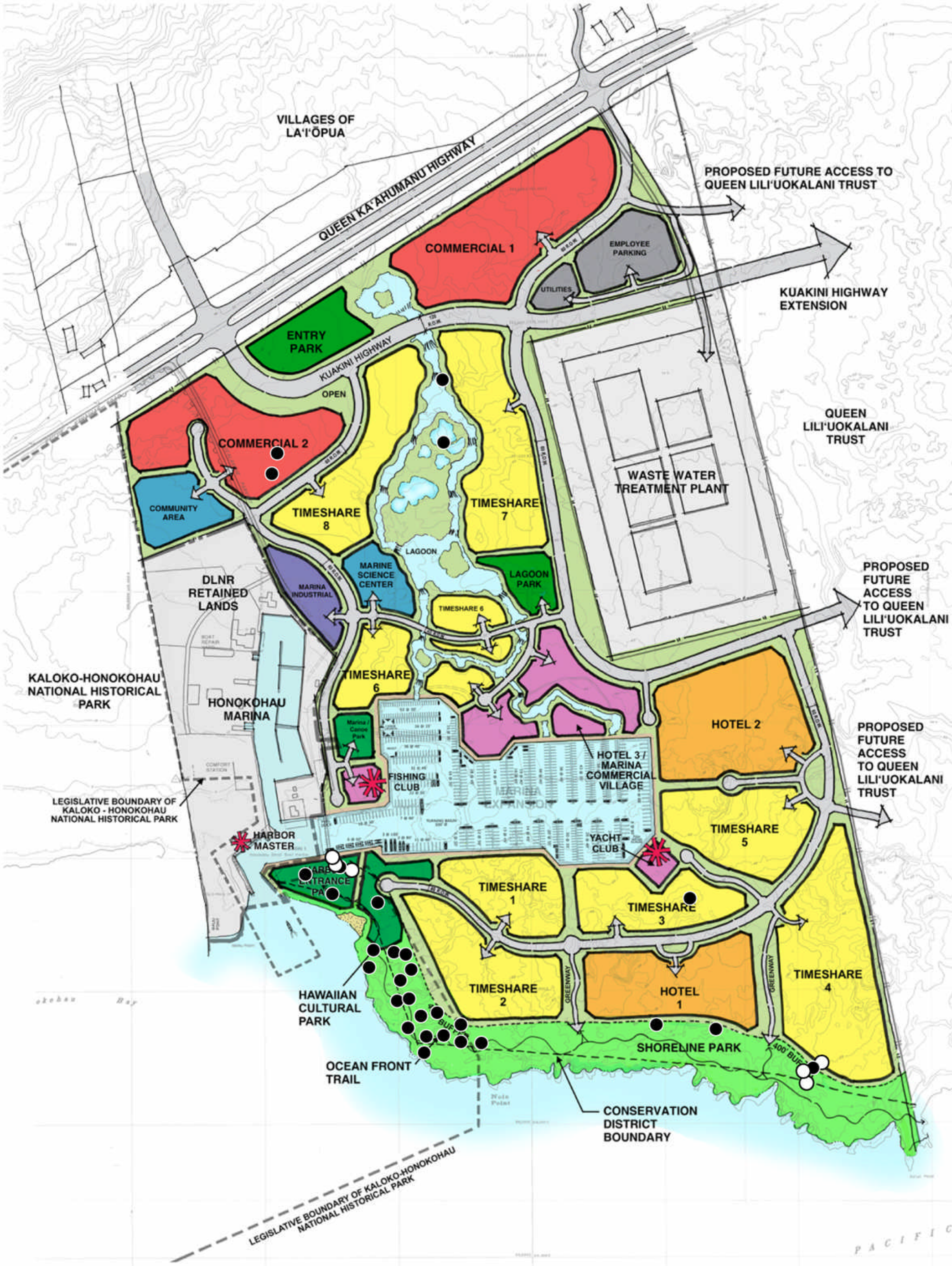
~~Increased boat traffic will result in increased low intensity sounds in the harbor area and along transit routes. The ecological role played by anthropomorphic sound in the marine environment has recently received heightened awareness. Evidence from declassified Department of Defense ocean recordings off of San Diego show that background sound levels off-shore of the harbor have increased approximately ten-fold in 30 years. Much of this increase in sound level has been ascribed to large ship traffic. While intense sound levels can adversely impact marine mammals and potentially other species, this level of sound pressure has not been shown to be produced by the small boats envisioned to occupy the new marina.~~

~~Adverse impacts of lower intensity noise, such as from small boat engines, have been very difficult to quantify. No definitive information is available to determine the level of impact produced by increase in small boat generated noise on fish, marine mammals and sea turtles. Given the sporting habit of spinners and other dolphins of bow-riding ships and small boat wakes, they are apparently not overtly impacted by vessel traffic noises.~~

~~However, boat-generated noises can be reduced by slowing boats to "slow no-wake" in the main traffic lane of the entrance channel. The State could also consider extending the "slow no-wake" lane out to the first green buoy. Appropriate signage to enforce these requirements is recommended.~~

~~3.9.6~~3.9.5 Ciguatera

Attachment 9



Source: PBR HAWAII

Plan is conceptual only and subject to change

Figure T: Revised Archaeological Resources Location Map

Legend

- Timeshare
- Hotel
- Commercial
- Marina Retail
- Marina Support / Commercial
- Marine Science Center / Community Area
- Utilities / Hotel Facilities
- Recreation / Open
- Shoreline Park
- ● Archaeological Sites Recommended for Preservation
- ○ Inaccurately Depicted in DEIS and Are Not Included as Recommended for Preservation

N E S W

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